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Africa Research in Sustainable Intensification for the Next Generation - West Africa

Research in sustainable intensification of cereal-based farming systems in the Guinea-Sudan-Savanna of West Africa

**2014-2016 Work plans**

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| March 2015 |
| www.africa-rising.net |



The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government’s Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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| **Partners and their roles** | | | | |
| **Name** | **Abbreviation** | **Ghana** | **Mali** | **Role/responsibility** |
| Afrique Verte, Mali | 1AMASSA |  | + | On-farm and household nutrition studies with ICRISAT. |
| Association Malienne d’Eveil et de Developpement Durable | 1AMEDD |  | + | On-farm field trials and household nutrition studies with ICRISAT. |
| Agricultural Development & Value Chain Enhancement Program | ADVANCE II | + |  | Assist with market linkages, joint demonstration of technologies |
| Animal Research Institute | ARI | + |  | R4D on livestock production (sheep and goats) with ILRI. |
| Agricultural Technology Transfer Project | ATT | + |  | Assist with the introduction of new labor-saving technologies. |
| The World Vegetable Center | AVRDC | + | + | Lead R4D on vegetable production systems. |
| Community-based Organizations | CBOs | + | + | On-farm implementation of R4D activities. |
| International Center for Tropical Agriculture | CIAT | + |  | Lead R4D on land and soil management. |
| L’ong-Centre d’Appui a l’ Autopromotion pour le Development-ci-apresaenommee | L’ONG-CAAD |  | + | On-farm groundnut intensification |
| Le Groupe de Recherches d’Actions et d’Assistance pour le Development Communautaire | L’ONG-GRAADECOM |  | + | On-farm groundnut intensification |
| Compagnie Malienne de Developpement des Textiles | CMDT |  | + | On-farm field trials and household nutrition studies. |
| Crops Research Institute | CRI | + |  | Breeder seed of improved cereals and legumes. |
| Food Research Institute | FRI | + |  | Household nutrition. |
| Grains and Legumes Development Board | GLDB | + |  | Production of foundation seeds. |
| Heifer International | 1HI | + |  | On-farm livestock production with IITA. |
| World Agroforestry Center | ICRAF |  | + | Lead R4D on agroforestry systems. |
| International Crops Research Institute for the Semi-arid Tropics | ICRISAT | + | + | Sorghum/millet-groundnut R4D with IITA and SARI. |
| International Food Policy Research Institute | IFPRI | + | + | Lead site selection, baseline survey and monitoring and evaluation. |
| Institut d’Economie Rurale | IER |  | + | Socio-economic and on-farm studies with ICRISAT. |
| International Institute of Tropical Agriculture | IITA | + | + | Overall project coordination and R4D research on cereal-legumes. |
| International Livestock Research Institute | ILRI | + | + | Lead R4D on ruminants in Ghana and natural resources governance in Mali. |
| Institute for Scientific and Technological Information | INSTI | + |  | Organize training and publish project document with IITA. |
| International Water Management Institute | IWMI | + |  | Lead R4D on water management. |
| Kwame Nkrumah University of Science and Technology | KNUST | + |  | Graduate student training and R4D on rural pig production. |
| Mouvement Biologique du Mali | 1MOBIOM |  | + | On-farm and household nutrition studies with ICRISAT. |
| Ministry of Food and Agriculture | MoFA | + |  | Scaling-out SI technologies and establishment of R4D platforms. |
| Ministry of Health | MoH | + |  | Household nutrition R4D with UDS and IITA. |
| Post-Harvest Losses Innovation Laboratory | PHL-IL | + |  | Joint studies on comparison of grain storage methods and aflatoxin |
| Savanna Agricultural Research Institute | SARI | + |  | R4D on cereal-legume-veg. systems with IITA, ICRISAT and AVRDC. |
| Seed Producers Association of Ghana | 1SEEDPAG | + |  | Production of certified seeds and training on seed production. |
| Small Scale Irrigation Innovation Laboratory | SSI-IL | + |  | Testing of small-scale irrigation options and model validation |
| Soil Research Institute | SRI | + |  | R4D on integrated soil fertility management with IITA. |
| University for Development Studies | UDS | + |  | Graduate training and R4D on rural poultry and pig production. |
| Wageningen University, The Netherlands | WU | + | + | R4D on farming systems characterization and graduate training. |
| 1Non-governmental organization | | | | |

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**Summary**

The work-plans are presented under five research themes, namely:

1. Partnerships and socio-economics assessment (Research Theme 1, RT1).

2. Intensification of cereal-legume-vegetable cropping (Research Theme 2, RT2).

3. Intensive livestock and integrated crop-livestock production (Research Theme 3, RT3).

4. Land, soil and water management (Research Theme 4, RT4).

5. Improving nutrition, food storage, value addition and mycotoxin management (Research Theme 5, RT5).

Theme 1 is cross-cutting. Capacity building and knowledge exchange and dissemination are embedded in all themes.

The 2013-14 research year work-packages are mapped under the research themes. In line with the recommendations of the mid-term project review, R4D and innovation platforms will be established and facilitated in both countries to ensure research is demand driven and to support scaling-up. Additionally, the ‘Technology Park’ approach will be adapted in Mali in line with the mid-term review evaluation to ensure integration of activities. Publication of research results and better communication among research teams within and across countries will be a major focus.

**1. Introduction**

**1.1 Africa RISING in West Africa**

The project is being implemented in 25 intervention communities in the three northern regions of Ghana (Fig. 1), and 10 villages in the Bougouni-Yanfolila and Koutiala districts of the Sikasso Region in southern Mali (Fig. 2). It is intended to result in spillover effects to other similar agro-ecological zones.

The implementation strategy, gender awareness and equity issues, scale of operation, knowledge transfer strategies and research hypotheses which contribute to the overall program research and development outputs have been outlined in the 2013-14 research year work plans.

**1.2. Research themes**

The 2014-2015 research year work-plans are presented under five research themes. Table 1 shows mapping of the 2013-2014 research year work-packages under the research themes. The themes are:

1. Partnerships and socio-economics assessment (Research Theme 1, RT1).

2. Intensification of cereal-legume-vegetable cropping (Research Theme 2, RT2).

3. Intensive livestock and integrated crop-livestock production (Research Theme 3, RT3).

4. Land, soil and water management (Research Theme 4, RT4).

5. Improving nutrition, food storage, value addition and mycotoxin management (Research Theme 5, RT5).

The work-plans are presented separately for each country for clarity and to ensure integration of activities within countries.

|  |  |  |
| --- | --- | --- |
| Table 1. Mapping of the 2013-14 research year work-packages under research themes in 2014-2015. | | |
| Theme | Work package | |
| 1 | 1 | Socio-economic studies on sustainable intensification in northern Ghana and southern Mali. |
|  |  |  |
| 2 | 2 | Raising and sustaining productivity in cereal-legume cropping systems in northern Ghana. |
|  | 4 | Integrating vegetables into cereal-legume cropping systems in northern Ghana. |
|  | 5 | Improving farm and field productivity and profitability in southern Mali. |
|  |  |  |
| 3 | 6 | Intensifying livestock and poultry production in northern Ghana and southern Mali. |
|  | 7 | Raising and sustaining productivity in crop-livestock systems in northern Ghana. |
|  |  |  |
| 4 | 8 | Land, soil and water management to intensify cereal-legume farming systems in Ghana. |
|  | 9 | Managing natural resources to increase watershed productivity in southern Mali. |
|  |  |  |
| 5 | 10 | Improving household nutrition and value addition in northern Ghana and southern Mali |

Theme 1 is cross-cutting. Capacity building and knowledge exchange and dissemination activities are embedded in all themes. The activities are linked within and across themes to ensure integration. They contribute to the expected outputs of the Africa RISING West Africa project, namely: characterization of the farming systems (Theme 1), increase productivity (Themes 2 and 3), conserve the natural resource base (Theme 4), improve household nutrition and link farmers to markets (Themes 1 and 6), capacity of partners strengthened and knowledge exchange and dissemination improved (Themes 1-5). A brief description of the research themes and potential research question to be addressed within the theme is given below.



Figure 1*.* Africa RISING intervention communities in Ghana.

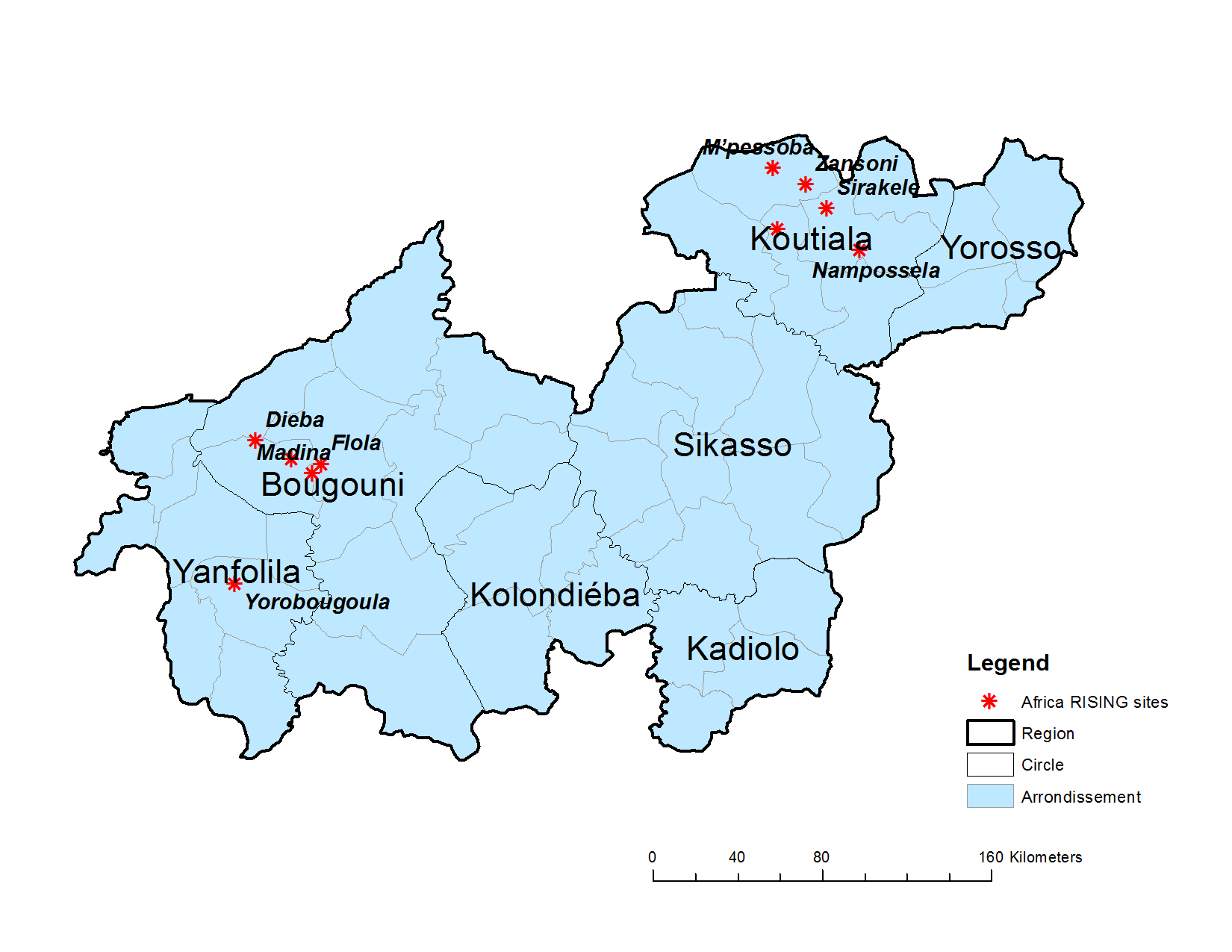


Figure 2. Africa RISING intervention villages in Mali.

**1.2.1 Partnerships and socio-economics assessment (RT1)**

This is a cross-cutting theme which addresses community mobilization and analysis, establishment of research-for-development (R4D) platforms at the community and district levels, stakeholder analysis and network mapping, baseline surveys, identification and validation of best-bet sustainable intensification (SI) technologies for scaling out, gender awareness and equity, markets analysis, cost-benefit analysis of SI technologies, project monitoring and evaluation and impact assessment.

Barriers to agricultural development are not only technological but also institutional (e.g., laws, regulations, attitudes, habits, practices, norms, values, culture, and incentives). Thus, many researchers and project managers in the field of agricultural development are currently confronted with studying, using and facilitation and/or implementing R4D platforms, which entails a shift away from traditional linear research-extension-farmer transfer of technology towards agricultural innovation systems. The R4D support the implementation of research and development; contribute to improving the relevance and impact of research; stimulate and strengthen interaction between multiple stakeholders; link different stakeholders to achieve a common objective; contribute to jointly identifying and solving complex problems; provide an enabling environment for innovation, and contribute to overcoming institutional barriers and creating institutional change. The mid-term external review of the project recommended establishment of community and district level R4D platforms to ensure that activities are demand driven. The establishment and facilitation of these platforms will be key activities during the 2014-15 research year.

Several trials are being conducted within the Africa RISING project in Ghana and Mali with the aim of providing scientific evidence for the bio-physical advantages of alternative agricultural technologies. The advantages of technologies can be seen from both bio-physical/ecological and socio-economic point of view. While these approaches have their own distinct features and analytical tools, they help to generate pieces of information which are complementary in nature regarding the performance of improved agricultural technologies. New technologies are being promoted for specific farmer typologies because they have advantages over the existing ones. However, socio-economic information (e.g., farmer preferences, labor requirements, net profit, adoption, gender, etc.) about the technologies is limited.

Adoption and diffusion of improved technologies by farmers is generally low due to lack of enabling market and market information, institutions and policies. The development and promotion of markets will help farmers to source for quality inputs at reasonable prices, and also allow them to sell their produce at profitable prices.

Research questions under this theme include:

* Who are the key actors in the R4D platforms at the community and district levels and how are they linked?
* Which SI technologies are socially acceptable and why?
* Which of the SI technologies are more profitable?
* Who is using the improved SI technologies or elements of technologies, where and why?
* Are the improved SI technologies being modified by different farmer or household categories?
* How is gender main-streamed into the research activities?
* What are the main constraints to the adoption of SI technologies?

**1.2.2. Intensification of cereal-legume-vegetable cropping (RT2)**

Small-scale, rainfed mixed farming predominates in the intervention communities in northern Ghana and southern Mali. Most farmers grow cereals (e.g.: maize, rice, millet and sorghum), legumes (e.g.: groundnut, cowpea, soybean, Bambara nut, pigeon pea) and vegetables for home consumption and cash. Cultivation is mainly by hand tools, with some farmers using animal draft implements.

Farmers produce vegetables throughout the year both under rainfed and irrigation. Major vegetables produced include: onion, okra, tomato, pepper and leafy vegetables. They can either be cultivated as sole crop or in association with cereals (maize, rice, sorghum or other cereals) and legumes (cowpea, groundnut, soybean, and pigeon pea) during the main cropping season, in rotation during the fallow season, or as relay crop during the transition periods preceding or succeeding the main cropping season.

Productivity of the cereal-legume-vegetable cropping systems is generally low due to several constraints, especially: erratic and unpredictable rains; intermittent drought; lack of knowledge of improved and appropriate technologies to increase productivity or expand the range of crops and crop rotations; lack of inputs, especially quality seed and fertilizer; use of low yielding varieties; poor management practices (low planting densities in pure and mixed stands, pest/disease and weed control, and nursery practices) and low soil fertility.

This theme will use participatory approaches to test, adapt and disseminate crop varieties and associated agronomic practices that will intensify the cropping systems and increase productivity. Among the research questions to be addressed under this theme are:

* What improved varieties and associated management practices will increase productivity of cereal-legume-vegetable cropping systems?
* What integrated soil fertility management practices will increase productivity and profitability of the cropping systems?
* Will a combination of improved crop varieties and agronomic practices result in higher food/feed yields, income than single technologies?
* Which cropping systems (rotations, intercrops, and relays) will increase the productivity and profitability of the cereal-legume-vegetable cropping systems?
* Which crop varieties and agronomic practices are more resilient and adapted to climate change?
* Which tree/shrub species and management options have potential for intensive fruit, vegetable and fodder production?

**1.2.3 Intensive livestock and crop-livestock systems (RT3)**

Small-scale livestock (cattle, sheep, goats, pigs, chickens, guinea fowls, turkeys, and ducks) and integrated crop-livestock farming systems predominate in most of the intervention communities in Ghana and Mali. Farmers grow cereals, legumes and vegetables, and raise livestock which provide meat and milk for food, manure for crop production, cash, and power for land cultivation and transport. In many communities, poor women and the youth derive their income from livestock keeping, especially sheep, goats, poultry, and pigs. The animals are mostly managed under extensive and semi-intensive systems with limited feed, shelter, health care, and breeding management. Available commercial feeds are expensive and thus unaffordable for many farmers. Farmers have limited access to veterinary services and improved livestock breeds. Inappropriate husbandry practices result in high mortality rates and low productivity.

The crop and livestock enterprises are weakly integrated resulting in poor nutrient cycling and low total productivity of the mixed farming systems. Grazing native pastures and crop-land under weedy fallow and crop residues are the main feed resources for cattle, sheep and goats. High grazing pressures on fallow lands in some communities reduce plant biodiversity and biomass and soil vegetation cover resulting in severe soil erosion and nutrient losses. Planting herbaceous and shrubby legumes to provide livestock feed, improve soil fertility and to suppress pests and diseases can improve the fallow lands.

Potential research questions to be addressed under the theme include:

* Which combinations of improved livestock breeds and husbandry practices will result in higher animal productivity, income and household food security?
* Which combinations of cereal and legume varieties and agronomic practice will optimize feed from the cereal-legume cropping systems?
* How can livestock be integrated into the cropping systems to increase nutrient cycling, and outputs of crop and livestock products?
* How will the integration of livestock into fallow systems influence the soil and vegetation resources and crop yields?
* Are there potential risks of integrating livestock into tree cropping systems?
* Which SI options can reduce the dry season feed gaps and increase intensive livestock production?
* What is the potential of small-scale irrigated methods for fodder production?
* What are the trade-offs between the use of mulch for feed and/or as mulch?

**1.2.4. Land, soil and water management (RT4)**

Water availability, soil quality and land suitability are basic to agricultural production in the Africa RISING intervention communities. However, all these resources are under increasing pressure in Northern Ghana as food and living standard demands increase with the rising population pressure. Among others, some of the entry points to managing these pressures while increasing production and buffering against shocks include judicious and economically feasible land, soil and water management strategies that address the chronic problems associated with soil erosion and subsequent nutrient losses; and low and erratic rainfall.

A number of opportunities and constraints related to land, soil and water management were identified during village and district level consultation meetings in 2012-13 and 2013-14 research years. They include: improved nutrient cycling at the farm level, improving soil fertility, reducing land and soil degradation, access to water for human and animal consumption and off-season irrigated vegetable production, innovations that reduce conflict between different stakeholders around the use of natural resources, and improved land, soil and water conservation technologies.

Water availability is becoming a growing concern due to erratic rainfall and sporadic occurrences of droughts. Constraints related to water availability during the rainy season are further compounded by inability to use other sources of water such as shallow wells for irrigated crop production. These constraints could be minimized through appropriate water management and supplementary irrigation/rainwater harvesting during the rainy season. In addition to this, the increasing demand especially for vegetables during the dry season could be met through sustained dry season production using for example shallow wells to tap on groundwater resources. To have such extra (dry season) crop, there is need for suitable irrigation technologies covering water extraction or lifting, storage, conveyance and application in the right volume and timing. Water extraction and delivery affect labor, cost and the amount that is applied to the crop. Irrigation scheduling and application rates affect the sustainability of the water source. Appropriate water management practices are necessary to enhance the productivity of crop and livestock farming systems in the implementation communities. This requires concerted participatory efforts by irrigation practitioners and farmers in getting water from various sources in the right amount and time to benefit crop and livestock production.

The existing farming systems entail use of both individual land holdings for crop farming and communal natural resources such as fodder trees and shrubs, water and grazing areas for livestock. The use of common resources directly impact on the household farm level productivity through nutrient flows between individual and communal lands. Sustainable and productive management of the common resources for the benefit of all rural household eases tensions among communities and pressure on the natural eco-system.

Research questions under the theme include:

* To what extent will small-scale irrigation options improve productivity in crop-livestock systems?
* What are the indicators of soil, water and land health under SI at the intervention sites?
* Which are the drivers of land use changes and trade-off for restoration strategies?
* Which SI options will improve the soil and land resources at the plot and watershed level?
* What are the immediate and long-term causes of conflict over natural resource use and what are the innovative options to reduce conflicts and associated problems?
* What are the strengths and weaknesses of existing natural resource governance institutions and how could they be strengthened?

Links will be established with the Small Scale Irrigation Innovation Laboratory to evaluate improved irrigation technologies (extraction or lifting, storage and conveyance) and water scheduling, and potential for irrigated fodder production.

**1.2.5 Nutrition, food storage, value addition and mycotoxin management (RT5)**

The nutritional status of most farm households, especially pregnant women, breastfeeding mothers, and children below 24 months of age, is often poor, leading to chronic malnutrition. The low nutritional status has been attributed to several factors including: low incomes, limited knowledge of healthy diets, poor child feeding practices, inappropriate food storage and processing methods that lead to high post-harvest losses due to insect pests and mycotoxins, as well as chemical contamination from use of grain protectants and fumigants. Improving the nutritional knowledge of women through Behavioural Change Communication (BCC); agricultural-based training to diversify diets through production and consumption of diversified and more nutritious foods of crop (legumes and vegetables) and livestock products (eggs, meat and milk); and nutritionally enhanced traditional foods and low-cost complementary foods, prepared with locally available nutrients using suitable small-scale production technologies at the household and community levels can help improve the nutritional status of rural households, especially women and children.

Farmers are at great risk of losing significant amounts of their harvest and consequently their income, due to their inability to properly store their grain - cereals (maize) and legume (cowpea and groundnut). Most farmers have limited knowledge on stored-grain management. Current farmer threshing and shelling practices lead to breakage. Poor drying leads to pest and disease infestation, high percentages of foreign matter and high moisture content that can lead to mycotoxin contamination. Storage is often done in homes using traditional silos and jute bags, without adequate protection from pests or routine fumigation leading to low grain quality. There are a number of innovative shelling, drying and storage technologies available, but these are yet to reach farmers, traders and government agencies involved in food storage. There is need to train farmers, extension agents and researchers on stored-grain management, especially with respect to the cowpea and groundnut.

Adding value to crop and livestock products to improve quality and market value is limited at the household and community levels. Where value addition is practiced (e.g., milk-processing), it is mostly done by women using traditional, outmoded, and time consuming methods which increase the work-load of women and result in low-quality products with limited shelf-life.

Aflatoxins are toxic metabolites, with carcinogenic properties, produced by *Aspergillus flavus, A. parasiticus* and *A. nomius*. Maize and groundnut are particularly prone to aflatoxin contamination. Presence of aflatoxins in crops compromises the safety of food and feed supplies and adversely impacts human and animal health resulting in deaths as well as significant economic losses to producers. Though postharvest management strategies and storage conditions to minimize contamination are known, these strategies are not completely effective since much of the contamination begins before harvest. Thus, sustainable management of aflatoxin contamination should begin in the field. One promising strategy is the biological control of aflatoxin via the use of native atoxigenic *A. flavus* which involves careful selection and introduction of highly competitive and widely adapted strains of atoxigenic *A. flavus* to soils prior to flowering of susceptible crops. Atoxigenic strains of *Aspergillus* sect. *flavi* belonging to widely distributed and diverse genetic groups have been selected, but quantitative data on their efficacy in farmers’ fields is limited.

Research questions to be addressed under the theme include:

* What is the current nutritional status of caregivers and children under 5 years at the intervention communities?
* To what extent can improving nutritional knowledge of caregivers improve the nutritional status of children less than 5 years?
* To what extent can community-based Behavioral Change Communication (BCC) alone and BCC in combination with agriculture-based education of women improve household nutrition?
* To what extent can women focused BCC in combination with agriculture-based education of women improve household crop diversity?
* Which combinations of technology packages can reduce vulnerability of households to food insecurity, food toxins (e.g., aflatoxins), low income and poor nutrition?
* To what extent can labor and time inputs into post-harvest activities be reduced through the use of machines, especially for women?
* Which atoxigenic strains of *A. flavus* can reduce aflatoxin contamination in maize and groundnut in farmers’ fields?
* To what extent can the various crop processing (handling) and storage technologies mitigate mycotoxin contamination in food?

Linkages will be established with the Post-Harvest Losses Innovation Laboratory to evaluate options to reduce stored-grain losses and aflatoxin contamination in maize and groundnut.

**2. Ghana work-plans**

**Theme 1: Socio-economics, partnerships and monitoring (RT1-Gh)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Asamoah Larbi | IITA | PhD | Crop-livestock systems | Leader, RT1-Gh-1 |
| Bekele Kuto | IITA | PhD | Agricultural economics | Leader, RT1-Gh-2, 3 |
| Gundula Fischer | IITA | PhD | Sociologist | Leader, activity RT1-Gh-3 |

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| **2. Objectives** | | | | | |
| 1 | Mobilize communities, revise list of beneficiaries and geo-reference participating households | | | | |
| 2 | Establish and inaugurate at least 6 district level R4D. | | | | |
| 3 | Conduct a stakeholder analysis to analyze existing stakeholders and their interests. | | | | |
| 4 | Analyze value chains identified by the R4D platforms at the district levels | | | | |
| 5 | Assess cost and benefit of interventions | | | | |
| 8 | Create knowledge sharing and learning framework to facilitate stakeholder interaction | | | | |
| 10 | Identify and validate different stakeholders and their potential roles in the R4D | | | | |
| 11 | Assess the adoption of sustainable intensification technologies | | | | |
|  | | | | | |
| **3. Activities/work-plans** | | | | | |
| **Activity RT1-Gh-1** | | Mobilize communities and establish R4D Platforms in Ghana | | | |
| Lead Scientist(s) | | Asamoah Larbi | | Institution: IITA | |
| Other scientist (s) | | Mary Asante, Abdul Nurudeen, Dominic Sobre | | | |
| Consultant | | To be identified | | | |
| Location(s) | | Intervention communities in Salvelugu, Tolon/Kunbungu, Bongo, Kassena-Nankana, Wa West and Nadowli districts | | | |
| **Procedures** | | | | | |
| *Sub-activity RT1-Gh-1.1: Community mobilization and workshops on 2014 activities:* Community consultation initiated in 2014 will continue. Community workshops will be organized to document farmers’ comments on the 2013 participatory trials. The 2014 list of interested farmers will be revised. Households will be tagged or geo-referenced for easy monitoring.  *Sub-activity RT1-Gh-1.2: Establishment of research for development platforms:* Preparations (involvement and validation of stakeholder) for establishment of R4DPs started in 2013 at all the intervention communities with the formation of farmer-based organizations. Identification, interviews, validation and recruitment of stakeholders will continue at the district level in all the regions. The R4DPs in the six districts will be launched between July and September 2014. | | | | | |
|  | | | | | | | |
| **Activity RT1-Gh-2** | | | Economic validation and monitoring adoption of sustainable intensification options | | | |
| Lead Scientists(s) | | | Bekele Kotu | | Institution: IITA | |
| Other scientist(s) | | | Saaka Buah, Francis Kusi, Mumuni, Abdulai,Mary Asante, Abdul Nurudee, Dominic Sobre, David Wawula, Shaibu Bedi | | | |
| Location(s) | | | Intervention communities in Salvelugu, Tolon/Kunbungu, Bongo, Kassena-Nankan, Wa West and Nadowli districts | | | |
|  | | | | | | |
| **Procedures** | | | | | | |
| *Sub-activity RT1-Gh2.1: Socio-economic validation of improved agricultural technologies.* A number of technologies are being identified and promoted for specific farmer typologies in biological trials in Ghana. However, socio-economic information about the technologies is lacking. The study aims to evaluate selected technologies from the socio-economic point of view. It will involve: 1) providing socio-economic input to publication of completed studies; 2) collection and analysis of data on on-going trials; and 3) in-depth socio-economic assessment of selected technologies.  *Sub-activity RT1-Gh-2.2: Analysis of the applications of SI practices in WA:* Agricultural intensification requires more inputs (such as labor and commercial inputs) per unit of land in order to produce more outputs, while its sustainability entails the use of multiple technologies in an integrated manner. Despite this fact, previous studies focused on adoptions of agricultural technologies separately (e.g. improved seeds, fertilizer). This piecemeal approach can only provide a partial answer to sustainable intensification of smallholder agriculture. Therefore, this study aims to examine the adoption of sustainable agricultural practices and technologies in an integrated manner using available AR baseline data for Ghana and Mali. | | | | | | |

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| **Activity RT1-Gh-3** | Monitoring the adoption of sustainable intensification options | |
| Lead Scientists(s) | Bekele Kotu | Institution: IITA |
| Other scientist(s) | Gundula Fischer | |
| Location(s) | Selected communities in the Northern, Upper East and Upper West Region | |
|  | | |
| **Procedures** | | |
| Several technologies have been identified and introduced to smallholder farmers in the target areas of the project to enhance the intensification of smallholder agriculture thereby improving the well-beings of the people. However, the realization of this outcome is not automatic and there may be obstacles that would operate against the initial expectations. This study is designed to provide analytical information on the adoption of technologies generated and promoted through the Africa RISING (AR) project. It will assess how well the technologies are being adopted by the farmers. It will also examine, through a network mapping, who is using which technologies or elements of technologies, where, why and how these are being modified by different farmer or household categories. It can be considered as an ongoing evaluation of the adoption process. | | |

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| **4. Activity schedule (RT1-Gh)** | | | | | | | | | | | | |
|  | 2014 | | | | 2015 | | | | 2016 | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Establishment/facilitation of R4D platforms | x | x | x | X | x | x | x | x | x | x | x | x |
| 2. Economic analysis validation |  |  | x | X | x | x | x | x | x | x | x | x |
| 3. Household adoption monitoring |  |  |  |  |  | x | x | x |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5. Expected results/deliverables** | | **2013** | **2015** | **2016** |
| 1 | Mobilize communities and establish 4-6 community level R4D Platforms | x | x | x |
| 2 | Report on feed markets and livestock value chains in Ghana |  | x |  |
| 3 | MSc dissertations on livestock value chains in Ghana |  | x |  |
| 4 | Cost benefit analysis of SI interventions completed |  | x | x |
| 5 | Link at least 100 farmers to markets |  | x |  |

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| --- | --- | --- | --- | --- |
| **6. Expected outcomes** | | Short | Medium | Long |
| 1 | Increased interaction among stakeholders through the R4D platforms | x | x |  |
| 2 | Research institutions use more R4D platforms and less of the linear approach |  | x | x |

**7. 2015 Budget** (US$)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Theme/Activity | Budget Line | IITA | MOFA | UAE |
| RT1-Gh-1 | Personnel | 20000 | 6000 |  |
|  | Services | 15000 | 4000 |  |
|  | Supplies | 5000 | 1500 |  |
|  | Travel | 5000 | 1500 |  |
|  | Overhead | 5000 | 1500 |  |
|  |  |  |  |  |
| RT1-GH-2 | Personnel | 20000 | 6000 |  |
|  | Services | 15000 | 4000 |  |
|  | Supplies | 5000 | 1500 |  |
|  | Travel | 5000 | 1500 |  |
|  | Overhead | 5000 | 1500 |  |
|  |  |  |  |  |
| RT1-Gh-3 | Personnel | 20000 | 6000 | 28000 |
|  | Services | 10000 | 4500 | 21000 |
|  | Supplies | 5000 | 1500 | 7000 |
|  | Travel | 5000 | 1500 | 7000 |
|  | Overhead | 5000 | 1500 | 7000 |
|  | **Total** | **140000** | **44000** | **70000** |
|  | Grand total |  | 254000 |  |

**Theme 2. Intensify cereal-legume-vegetable cropping (RTG2-Gh)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1. Research team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Asamoah Larbi | IITA | PhD | Crop-livestock, feeds | Leader, activity RT2-Gh 1, 2 and 3 |
| Saaka Buah | SARI | PhD | Agronomy | Leader, activity RT2-Gh 2, 3 and 4 |
| Jean-Baptise T | AVRDC | PhD | Vegetable breeding | Leader, activity GT2-5 |
| Mumuni Abdulai | SARI | PhD | Entomology | Entomologist, activity RT2-Gh-4 |
| Francis Kusi | SARI | MSc | Post-harvest | Entomology, activity RT-Gh-4 |
| Nicholas Denwar | SARI | PhD | Soybean breeding | Breeder seed , activity RT-Gh-4 |
| Roger Kanton | SARI | PhD | Agronomy | Agronomic, RT-Gh-5. |
| Theodore Avukpor | KNUST | BSc | Horticulture | MSc student |
| Mohammed Kadir | KNUST | BSc | Horticulture | MSc student |
| Naaba Jonathan | KNUST | BSc | Horticulture | MSc student |
| Iddrisu Bashiru | KNUST | BSc | Horticulture | MSc student |
| Haruna Abudulai | KNUST | BSc | Horticulture | MSc student |

**2. Objectives**

|  |  |
| --- | --- |
| 1 | Disseminate project results through publication of technical and non-technical papers/leaflets |
| 2 | Test and disseminate cereal-legume-vegetable cropping systems to increase productivity per unit area. |
| 3 | Develop and test integrated soil fertility management options to improve crop yields. |
| 4 | Improve productivity of irrigated and rainfed vegetable production. |
| 5 | Train extension agents, farmers and researchers (MSc and PhD students) |

**3. Activities and work plan**

|  |  |  |
| --- | --- | --- |
| **Activity RT2-Gh-1** | Publication of results from completed studies | |
| Lead Scientist(s) | Asamoah Larbi, Saaka Buah | Institutions: IITA, SARI |
| Other scientist (s) | Francis Kusi, Mumuni Abdullaih, Nicholas Denwar, Roger Kanton, James Kombiok | |
| Location(s) | Tamale, Bolga, Wa | |
|  |  | |
| **Procedures** | | |
| *Sub-activity RT2-Gh-1.1: Developing a database of completed experiments:* Second year data collection for three multi-locational agronomic trials were completed during the 2013 growing season. Data from those experiments will be put into a database which will be accessible to the responsible scientists.  *Sub-activity RT2-Gh-1.2: Data analysis and publication of experimental results:* Responsible scientists for the three experiments referred to in sub-activity 1 will be assisted to analyze their data in consultation with a biometrician. The responsible scientists will draft papers for international peer reviewed journals. The papers will be circulated to the project scientists for review and submitted for publication through the project coordination office. | | |

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| **Activity RT-Gh-2** | Intensifying cereal-legume cropping systems | | | |
| Lead Scientists(s) | Asamoah Larbi, Eastern Khali, Issahaku Zakaria, | | | Institution: IITA, PAS |
| Other scientist(s) | Abdul Rahman Nurudeen, Dominic Sobreh, Mary Asante, Shaibu Bedi, Daniel Akakpo, Eastern Khana-Khali, Issahaku Zakaria | | | |
| Student(s) | Haruna Abdullai | | | |
| Locations(s) | All intervention communities | | | |
|  |  | | | |
| **Procedures** | | | | |
| *Sub-activity RT2-Gh-2.1: Scaling-up cereal-legume strip cropping:* Households will be allowed to select from a basket of cereal (maize, sorghum and early millet) and legume (groundnut, cowpea and soybean) options. For each option, the cereal and legume will be sown in the following row combinations: 2 cereals: 2 legumes; 2 cereals: 4 legumes. Participating farmers will be given input and technical support to establish their plots. A basal dose of 100kg/ha NPK (15:15:15) will be given followed by a selective application of 20kg/ha N only on cereal rows and two sprays of insecticide only on the legumes. At harvest, crop residues from half of the plot will be removed to feed the farmers’ sheep and goats, while residues on the other half will be retained for soil fertility improvement. Both biological (grain and fodder yield, week biomass and diversity, soil chemical and physical properties) and socio-economic (farmer preferences, labour input, gender distribution of chores) data will be collected. | | | | |
|  | | | | |
| *Sub-activity RT2-Gh-2.2: Scaling-up cereal-legume rotations:* Households will select from a basket of cereal (maize, sorghum and millet)-legume (cowpea, groundnut, soybean and pigeon pea) rotation options. They will be given inputs and technical support to establish their plots. The crops will be rotated annually. Both biological (grain and fodder yield, week biomass and diversity, soil chemical and physical properties, soil fauna) and socio-economic (farmer preferences, labor input, gender distribution) data will be collected. Data will be analyzed using households as replicates. | | | | |
|  | | | | |
| *Sub-activity RT2-Gh-2.3: Scaling-up ‘Zai’ and fertilizer micro-dosing:* Zai farming is an innovative technology which involves the burial of manure/organic matter in holes/pits and planting the crop later on top of the pit. It improves water holding capacity, water infiltration and nutrient content of the soil. Fertilizer micro-dosing involves the application of small, affordable quantities of inorganic fertilizer with the seed at planting time. This is followed by top-dressing 6 weeks after planting. A combination of these two methods is referred to as ‘Zai-micro dosing’.  In Ghana, ‘Zai’ has been successfully introduced on a limited scale to farmers in the East Gonja, East Mamprusi districts in the Northern region and Garu and Builsa districts in the Upper East region by the Presbyterian Agricultural Services. There is need for research on: 1) cost benefit analysis of the ‘Zai’ and fertilizer micro-dosing, 2) potential increase in grain yield of ‘Zai’ and fertilizer micro-dosing over farmers’ practice in the Africa RISING intervention communities, and 3) comparative analysis of the effect of ‘Zai’ and fertilizer micro-dosing on maize, sorghum, millet and vegetables. The purpose of this activity is to evaluate and disseminate the ‘Zia’ and fertilizer micro-dosing techniques on-farm.  A randomized complete design with 30-50 households (replications) per treatment in each of 6 communities (2 communities per region) will be used with the following treatments: 1. Farmers’ practice (control); 2. Zai; 3. Micro-dosing; and 4. Zia and micro-dosing. Fields of participating households will be divided into four plots. Treatments will be randomly assigned to plots. Maize will be used as the test crop. Input and output data will be recorded. | | | | |
|  | | | | |
| *Sub-activity RT2-Gh-2.4: Evaluation of cereal-sesame cropping systems:* Mono-cropping of sesame (*Sesamum indicum*) is being promoted for cash to diversify smallholder income in northern Ghana. Although sesame can be intercropped with cereals (maize, sorghum, millet) to produce a sesame cash crop from the same fields, quantitative data on the cereal-sesame intercropping is scanty. The objective of this activity is to evaluate agronomic options for integrating sesame into maize, sorghum and millet cropping systems.  *Sub-sub-activity RT2-Gh-2.4.1: Fertilizer and time of sowing sesame into maize effects on grain yield and income*: A split-plot design replicated in 3-4 communities per region will be used. Main-plots are recommended fertilizer and higher fertilizer rates for maize; and sub-plots are: 1) Sole maize, 2) Sole sesame 3) Maize + sesame planted on the same day; 4) Maize + sesame planted one week after maize, and 5) Maize + sesame planted two weeks after maize. Maize will be planted in rows 75 cm apart and 40 cm within rows with 2 stalks per station at the beginning of the rainy season. Sesame will be planted midway between each maize row with row spacing of 6 cm at 0, 1 and 2 weeks after planting maize.  *Sub-sub-activity RT2-Gh-2.4.2: Method of sowing sesame and maize planting density effects on labor requirements and grain yield:* A split-plot design replicated in 3-4 communities per region will be used. Main-plots will be hand broadcasting and drilling in row of sesame between maize. Main-plots are: hand broadcasting and drilling in rows. Sub-plots are maize planting density: 5, 10 and 15 plants/m2. Maize will be planted in rows 75 cm apart and 40 cm within rows with 2 stalks per station at the beginning of the rainy season. Sesame will be planted midway between each maize row with within row spacing of 6 cm at 2 weeks after planting maize. For both trials, data will be collected on growth of maize and sesame, light interception/leaf area index, weed diversity and biomass, grain yield of maize and sesame, soil temperature, soil moisture, and plant pests and diseases. Output and input data will be collected for cost benefit analysis. | | | | |
|  | | | | |
| **Activity RT2-Gh-3** | Testing and dissemination of improved crop varieties and agronomic practices | | | |
| Lead scientist(s) | Asamoah Larbi | | IITA | |
| Other scientist(s) | Bekele Kotu, Abdul Nurudeen, Dominic Sobreh, Mary Asante, Julius Yilzagla, Daniel Akakpo, Shaibu Bedi | | | |
| Location(s) | Selected intervention communities in the three regions | | | |
|  | | | | |
| **Procedures** | | | | |
| Four ‘mother-baby’ trials started in 2013 to test and demonstrate crop variety and combinations of variety and agronomic options will continue for the third year. A split-plot design replicated in 4-6 communities per region will be used in each trial. There will be 30 ‘babies’ per community for each mother trial. The ‘mother’ trials are managed by researchers and farmers in a ‘Technology Park’ to allow learning by experimentation, while the ‘baby’ trials are managed by the farmers. Data on grain and fodder yields, soil chemical composition, and farmers’ preferences will be collected. Grain yield and quality, soil chemical properties, and farmer preferences would be monitored. The mother trials are:  *Sub-activity RT2-Gh-3.1*: Recommended (60kg/ha N-40kg/ha P2O5-40kg/ha K2O), and higher (90kg/ha N-40kg/ha P2O5-40kg/ha K2O) fertilizer rates (main-plots) effects on grain yields of 12 hybrid maize varieties (sub-plots).  *Sub-activity RT2-Gh-3.2*: Insecticide spraying regime - once or three times (main-plots) effects on grain yield of six cowpea varieties (sub-plots).  *Sub-activity RT2-Gh-3.3*: Grain yields of early and late maturing soybean varieties (main plots) as affected by integrated soil fertility management (*Rhizobium* inoculation, phosphorus fertilizer and an organic fertilizer; sub-plots).  *Sub-activity RT2-Gh-3.4*: Evaluation and adaptation of sorghum and millet hybrids in Ghana. This activity is jointly implemented by ICRISAT’s sorghum and millet plant breeders and SARI scientists. About 6-10 sorghum elite sorghum hybrids will be evaluated on-station using a randomized complete block design with 3-4 replications.  *Sub-activity RT2-Gh-3.5: Effect of nitrogen fertilizer rates*. Grain yield responses of four improved rice varieties (Exvanka, Togo Mashall, Tox-233 and Nerica) plus a farmers’ variety to increasing N levels (0, 40, 80 120 and 160kg/ha) will be tested on-farm at the Navrongo hub. Interested households will be selected and given seed and fertilizer. Grain yield and farmer preference will be recorded. | | | | |
|  |  | | | |
| **Activity RT2-Gh-4** | Integrated soil management options to improve productivity of maize-legume systems | | | |
| Lead Scientists(s) | Saaka Buah | Institution: SARI | | |
| Other Scientist (s) | Peter Asongre, Roger Kanton, | | | |
| Locations(s) | Two communities in each region | | | |
|  |  | | | |
| **Procedures** | | | | |
| *Sub-sub-activity RT2-Gh-4.1: Maize-soybean rotation:* An on-station maize-soybean rotation trial to evaluate the response of soybean to organic, mineral and *Rhizobium* inoculants started in 2013 and will continue. Treatments are: 1) soybean (no soil amendment), 2) soybean + inoculants, 3) soybean + inoculants + 60kg/ha P2O5, 4) soybean + inoculants + fertisol, 5) soybean + inoculants + fertisol + 60kg/ha P2O5), 6) soybean + inoculants + 25-60-30kg/ha as N, P2O5, andK2O, 7) continuous maize and 8) continuous soybean. The design is a randomized block with four replications. Plot size will be 4.5m x 5m (6-row plots). Soybean will be spaced 75cm x 5cm and maize at 75cm x40 cm.  *Sub-sub-activity RT2-Gh-4.2: Maize-groundnut rotations:* A maize-groundnut rotation trial to evaluate the response of groundnut to organic, mineral fertilizers and *Rhizobium* inoculants started in 2013 and will continue. The design is a randomized block with four replications. Treatments are: 1) groundnut alone (no soil amendment), 2) groundnut + inoculants, 3) groundnut + inoculants + 60kg/ha P2O5, 4) groundnut + inoculants + fertisol, 5) groundnut + inoculants + fertisol + 60kg/ha P2O5, 6) groundnut + inoculants + 25-60-30kg/ha as N, P2O5, andK2O) continuous maize and 8) continuous groundnut. Plot size will be 4.5m x 5m (6-row plots). Groundnut will be spaced 60cm x 10cm and maize at 75cm x 40cm.  *Sub-sub-activity RT2-Gh-4.3: Maize-cowpea rotations:* An on-station maize-cowpea rotation trial to evaluate the response of soybean to organic, mineral and *Rhizobium* inoculants started in 2013 and will continue. Treatments are: 1) cowpea alone (no soil amendment), 2) cowpea + inoculants, 3) cowpea + inoculants + 60kg/ha P2O5, 4) cowpea + inoculants + fertisol, 5) cowpea + inoculants + fertisol + 60kg/ha P2O5/ha), 6) cowpea + inoculants + 25-60-30kg/ha as N, P2O5, andK2O, 7) continuous maize and 8) continuous cowpea. The design will be a randomized block with four replications. Plot size will be 4.5m x 5m (6-row plots). Cowpea will be spaced 60 cm x 10 cm and maize at 75cm x 40cm. Plant height, days to flowering, pods per plant, grain and stover yields, harvest index and soil chemical properties will be monitored in all trials. Pest and diseases will be monitored. | | | | |

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| **Activity RT2-Gh-5** | Intensification of rainfed and irrigated vegetable production systems | |
| Lead Scientist(s) | Jean-Baptise Tingegre | Institution: AVRDC |
| Other scientist(s) | Regine Kamga, Francis Kusi, Issah Sugri, Dominic Sobreh, Salim Lamini, Brain Akakpo, Yelipoie Comfort | |
| Student(s) | Theodore Eyram Avukpor, Mohammed Abdul Kadir, Naaba Jonathan,Iddrisu Bashiru | |
| Location(s) | Three selected communities in each region | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT2-Gh-5.1: Improving productivity of dry season vegetable cropping systems.* Best practice hubs will be established in selected communities to evaluate and demonstrate production of pure stands (mono-crops) of vegetables under irrigation during the dry season using the ‘mother-baby-trial’ approach. Treatments to be considered will include: vegetable species and/or varieties, agronomic practices (mulch and no-mulch, planting density, fertilizer rates, pest management), and irrigation systems (hand watering from wells, sprinkle and drip irrigation).  *Sub-activity RT2-Gh-5.2: Improving productivity of rainy season vegetable cropping systems.* As above, participatory testing will be carried out to assess the suitability of selected high value, multiple disease-resistant and nutrient-dense vegetable cultivars for cultivation under mixed cropping regimes with cereals ( maize, sorghum, and millet) and/or legumes (cowpea, pigeon pea, and soybean). All trials will include sole vegetable and cereal plots to serve as checks to assess the performance of the vegetables in the integrated systems.  *Sub-activity RT2-Gh-5.3*: *Hands-on training on best production practices and post-harvest handling* It is proposed to cluster demonstration and training activities around best practices hubs to be set-up in each of two regions (Northern and Upper East) each connecting to target communities in each of two districts per region. Farmers (households) will be trained, local seed actors/enterprises and extension staff’s knowledge reinforced in intensive vegetable production, integration of vegetables into cereal-legume production systems, community based seed production and storage, post-harvest management. Field days and exchange visits (possibly to neighboring countries) will be used (a) to raise awareness on vegetable-enriched food preparations that preserve or enhance nutritional content, particularly for women and children, (b) to raise awareness on exotic and little-knownr vegetables and legumes and (c), exposure to simple post-harvest handling options that reduce losses and optimize returns in the market. | | |

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| **4. Theme RT2-Gh activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Publication of papers |  | x | x | x |  |  |  |  |  |  |  |  |
| 2. Test/spread cereal-legume cropping |  | x | x | x | x | x | x | x | x | x | x | x |
| 3. Evaluate new cropping options |  | x | x | x | x | x | x | x | x | x | x | x |
| 4. Test integrated soil fertility options | x | x | x | x | x | x | x | x | X |  |  |  |
| 5. Improve vegetable production |  | x | x | x | x | x | x | x | X | x |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5. Expected results/deliverables** | | **2014** | **2015** | **2016** |
| 1 | Publish journal papers | x | x | x |
| 2 | Farmer preferred cereal-legume cropping systems | x | x | x |
| 3 | Integrate soil fertility management options | x | x | x |
| 4 | Cost benefit analysis of 5-10 interventions completed | x | x | x |
| 5 | At least 2 PhDs and 4 MSc students defend dissertation research | x | x | X |
| 6 | Agronomic packages to improve irrigated and rainfed vegetable production | x | x | X |
| 7 | At least 1000 farmers exposed to SI technologies | x | x | X |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **6. Expected outcomes** | | Short | Medium | Long |
| 1 | More households are integrating legumes into cropping systems | x | x |  |
| 2 | Households adopt cereal-legume rotations and intercropping |  | x | x |
| 3 | More households are integrating vegetables into their cropping systems |  | x | x |
| 4 | Farmers are adopting improved agronomic practices | x | x | x |

**7. 2015 Budget** (US$)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Theme/Activity | Budget line | IITA | AVRDC | SARI | MOFA | KNUST | UDS |
| RT2-Gh-1 | Personnel | 10000 |  |  |  |  |  |
|  | Services | 15000 |  |  |  |  |  |
|  | Supplies | 5000 |  |  |  |  |  |
|  | Travel | 5000 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| RT2-Gh-2 | Personnel | 30000 |  | 5000 | 20000 | 15000 | 4000 |
|  | Services | 10000 |  | 2000 | 3000 | 7000 | 2000 |
|  | Supplies | 30000 |  | 3000 | 3000 | 4000 | 3000 |
|  | Travel | 10000 |  | 2000 | 3000 | 4000 | 1000 |
|  |  |  |  |  |  |  |  |
| RT2-Gh-3 | Personnel | 30000 |  |  |  |  |  |
|  | Services | 15000 |  |  |  |  |  |
|  | Supplies | 25000 |  |  |  |  |  |
|  | Travel | 10000 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| RT2-Gh-4 | Personnel |  |  | 15000 |  |  |  |
|  | Services |  |  | 10000 |  |  |  |
|  | Supplies |  |  | 10000 |  |  |  |
|  | Travel |  |  | 5000 |  |  |  |
|  |  |  |  |  |  |  |  |
| RT2-Gh-5 | Personnel |  | 50000 |  |  |  |  |
|  | Services |  | 20000 |  |  |  |  |
|  | Supplies |  | 45000 |  |  |  |  |
|  | Travel |  | 15000 |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | Total | **195000** | **130000** | **52000** | **29000** | **30000** | **10000** |
|  | Grand total |  |  |  | 446000 |  |  |

**Theme 3: Intensive livestock and integrated crop-livestock production (RT3-Gh)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1. Research team** |  |  |  |  |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Augustine Ayantunde | ILRI | PhD | Feeds utilization | Leader activity RT3-Gh-1 |
| Tunde Amole | ILRI | PhD | Feeds, animal husbandry | Feed assessment |
| Franklin Avornyo | ARI | PhD | Feeds, animal husbandry | Small ruminant production |
| Asamoah Larbi | IITA | PhD | Crop-livestock production | Leader activities RT3-Gh-2-6 |
| Roland Kanlisi | HI | MSc | Veterinary epidemiology | HI project oversight |
| Ebenezer Ghamli | HI | DVM | Veterinary medicine | Animal health |
| Michael Boateng | KNUST | PhD | Monogastric nutrition | Graduate supervision |
| Terry Ansah | UDS | MSc | Ruminant nutrition | Feed resources |
| Addah Weseh | UDS | PhD | Feeds, animal husbandry | Feed resources |
| Henry Alagma | UDS | BSc | Ruminant nutrition | MSc student |
| Mary Awuni | UDS | BSc | Monogastic nutrition | MSc student |
| Amponsah Bright | KNUST | BSc | Pig production | MSc student |
| Raphael Ayizanga | KNUST | MSc | Animal breeding | PhD student |
| Solomon Kolan | UDS | MSc | Nutrient cycling | PhD student |

|  |  |
| --- | --- |
| **2. Objectives** | |
| 1 | Test feed/health options to improve productivity and nutrient cycling in sheep/goat systems |
| 2 | Publish a booklet on rural poultry and pig farming systems in Ghana. |
| 3 | Evaluate options to increase productivity of rural poultry production. |
| 4 | Evaluate options to improve productivity of rural pig production systems. |
| 5 | Test and disseminate options to increase crop and livestock outputs from fallow lands |
| 6 | Test and disseminate agronomic strategies to optimize feed from cereal-legume cropping systems |
| 7 | Identify high-yield and better quality cereal and legume crop genotypes for food and feed |
| 8 | Improve capacity of extension staff, researchers and farmers in integrated-livestock production. |

**3. Activities and work plans**

|  |  |  |
| --- | --- | --- |
| **Activity RT3-Gh-1** | Feed and health interventions for improved small ruminant production | |
| Lead Scientist(s) | Augustine Ayantunde | Institution: ILRI |
| Other scientist(s) | Franklin Avornyo, Addah Weseh, Sadat Salifu, Tunde Omole, Solomon Kolan | |
| Graduate students | Solomon Kolan | |
| Location(s) | Botingli, Tibali, Duko, Gia, Nangua, Guo, and Zanko | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT3-Gh-1.1: Feed and health interventions for improved small ruminant production in Ghana:* It has been demonstrated that simple interventions involving disease control, improved nutrition and better management lead to marked positive effects on small ruminant performance and productivity. Building on activities conducted in 2012 and 2013, feed and health interventions will be carried out in 9 communities involving 3 treatments (Treatment 1 = health intervention: vaccination against PPR and Pasteurellosis and deworming using Ivermectin; Treatment 2= health intervention as above and supplementary feeding of balanced rations) and a control (Treatment 3 = no health and no feed intervention). The health interventions will be administered by officials of the Ministry of Food and Agriculture in each region. One village will be selected in each region for each treatment making three villages per region. All small ruminants (sheep and goats) in the six villages (2 villages per region) with health interventions will be vaccinated against PPR and pasteurellosis, and will be dewormed. The feed interventions will be applied to 10 households in one village per region. Participating farmers will be provided with necessary feed ingredients and will be trained in mixing the ingredients to be used as supplement for their animals. In all the nine villages to be selected for the study, 10 households will be selected for monitoring of their flocks based on their willingness and ownership of at least 6 sheep and 6 goats. All sheep and goats in these households will be ear-tagged and weighed monthly. Manure produced will be collected and weighed monthly. A research assistant will be based in each village for the monitoring of the flock dynamics of the selected households in terms of entries (birth, purchase, animal received as gift or on loan) and exits (death, sales, and slaughter for household consumption, animal given out as gift or loan). Cost-benefit analyses will be conducted to assess the profitability of feed and health interventions. The 3 treatments explained above will be applied at a village level because of the nature of the treatments (in particular the health intervention). The villages in the same region (3) will be considered as a ‘block’ given that they are close enough and matched enough (on agro-ecological and socio-economic profile). The villages will be RANDOMLY allocated to one of the 3 treatments. Mixed effect models will be used for ANOVA for any response variable with Region effect (2 degrees of freedom), Treatment effect (2 d.f.) and 4 d.f. for the residual and each treatment has 3 replications / villages.  *Sub-activity RT3-Gh-1.2: Building capacity of smallholders in small ruminant production in Ghana:* Workshops will be organized to train farmers on many aspects of small ruminant production including disease control, feed formulation, better animal management practices and marketing. For building the capacity of the local communities in disease control, key members of livestock farmers’ association will be trained in each community by the veterinarians from Ministry of Food and Agriculture in diagnosis of common small ruminant diseases, record keeping and in providing preliminary treatments subject to the national law for the operations of Community-based Animal Health Workers. The community members to be trained will also be responsible for providing timely situation report to the veterinary services at the district level. Training will also be conducted on conservation and improvement of crop residues as animal feed. Specifically, the training will include: (i) Silage making with cassava peels, fresh groundnut and Bambara haulm/vines. Immediately after harvest, groundnut haulms still have reasonable amount moisture. This makes them a suitable feed resource for ensiling. When they are allowed to stay on the field under rain before being collected, they lose a significant amount of nutrients through leave shattering and leaching. (ii) Chemical treatment to improve nutritional quality and efficiency of utilization of cereal straw such as maize and rice straw.  *Sub-activity RT3-Gh-1.3: Nutrient flows in small ruminant production systems in Ghana:* Quantifying the nutrient use in smallholder livestock production systems is essential to balancing nutrients supplied in feeds to animals’ requirements, leading to improved livestock production, and consequently whole farm productivity and economic profitability. Also this is important to identify options or strategies for better nutrient management in the systems thereby reducing waste and loss. Eight out of the 20 households to be selected under sub-activity 1.1 will be selected in the three communities in each region (Upper West, Upper East and Northern regions) on the criteria of integration of crop and livestock systems, and willingness to participate in long term study. The households will be monitored over 24 months to address seasonal variations in nutrient use. Feeding practices of the selected household will be monitored as well as manure production of the household flock. Feed and fecal samples will be collected for laboratory analysis to determine nutrient inflows and outflows in the systems. This activity will be carried out along with activity on improving small ruminant production. | | |

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| **Activity RT3-Gh-2** | Evaluate and disseminate options to intensify integrated crop-poultry production | |
| Lead Scientist(s) | Asamoah Larbi | Institution: UDS, IITA |
| Other Scientist(s) | Herbert Die, Michael Boateng, Roland Kansali, Ebenezer Ghamli, Emmanuel Nartey | |
| Student(s) | Safo-Kantaka G, Daniel Apalibe, Raphael Ayizanga | |
| Location(s) | Tibali, Duko, Botingli, Tibognayili, Cheyohi, Samboligo, Bonia, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | |
| **Procedures** | | |
| *Sub-activity RT3- Gh-2.1: Publish survey report into a booklet:* A survey of rural poultry production systems in the intervention communities was completed in 2013. The survey report will be edited and published into a booklet.  *Sub-activity RT3-Gh-2.2: Develop, evaluate and disseminate improved technologies to intensify poultry production*: The survey in 2013 identified lack of enabling institutions and policies, poor market access, lack of improved breeding, inappropriate husbandry (housing, feeding, breeding and health care) practices, as well as lack of information/knowledge as key constraints to rural poultry production. In 2015, farmer participatory research will be conducted to test a combination of housing, feeding and health packages to address the constraints. The exact packages to be tested will be determined from consultations with farmers. Most likely combinations will be to test the traditional systems of management (control) and improved management (housing, health-care and feeding) using a randomized complete block design with districts as blocks. . Data to be collected will include matured live-weight, duration to maturity, mortality, duration of brooding, number of eggs, production costs, income, quantity of manure and profit over a period of 40 days. Trials will be conducted on both domestic chicken and guinea fowls. | | |

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| **Activity RT3-Gh-3** | Develop, test and disseminate options to intensify rural pig production | |
| Lead Scientist(s) | Michael Boateng | Institution: KNUST, IITA |
| Other Scientist(s) | Asamoah Larbi, Ben Alenyorege, I Mohammed | |
| Consultant(s) | Daniel Okine | |
| Student(s) | Raphael Ayizanga, Amponsah Bright, Mary Awuni | |
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**Procedures**

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| *Sub-activity RT3-Gh-3.1: Publish survey report into a booklet*: A survey of rural pig production in 2013 identified lack of enabling institutions and policies, poor market access, lack of improved breeding, inappropriate husbandry (housing, feeding, breeding and health care) practices as key constraints to rural pig production. On-farm research will be conducted to address the constraints.  *Sub-activity RT3-Gh-3.2: Develop, evaluate and disseminate technologies to intensify rural pig production:* In 2015, farmer participatory approaches will be used to develop, evaluate and disseminate a combination of housing, feeding, breeding and health care options to improve and intensify rural pig production. These will include trials on: comparison of extensive versus intensive management; effect of supplementation in performance of grower and finisher pigs under the free range management system; a survey to document green forage species fed to pigs, and the performance of growing pigs supplemented with different levels of concentrates; development and testing of breeding strategies to reduce inbreeding, meat processing and linking farmers to markets. In all trials, feed intake, body weight gain, feed conversion efficiency, mature live-weight, mortality rate, production costs and net profit will be recorded. The impact of the improved technologies on household income will be assessed.   |  |  |  | | --- | --- | --- | | **Activity RT3-Gh-4** | Evaluate options to integrate livestock into fallow lands to increase productivity | | | Lead Scientist(s) | Asamoah Larbi, Terry Ansah, Bekele Kotu | Institution: IITA, UDS | | Other Scientist(s) | Roland Kanlisi, Emmanuel Nartey, Ebenezer Ghamli | | | Graduate student(s) | Abdul Nurudeen | | | Location(s) | Tibali, Duko, Botingli, Tibognayili, Cheyohi, Samboligo, Bonia, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | | | **Procedures** | | | | *Sub-activity RT3-Gh-4.1.1: Identify fallow land management constraints and opportunities and establish community-based fallow land management committee (FLMC):* Organize focal group discussions with farmers in the target communities to identify key constraints and opportunities for managing fallow land for livestock production. Conduct multiple-site survey of production systems to complement and fill information gaps. Document indigenous knowledge on fallow land-livestock systems. Organize workshops to discuss baseline information and identify the social, institutional and economic determinants of unsustainable use of fallow lands, and develop feasible options for improved use and management of these resources. Organize workshops to discuss results and identify socio-economic and bio-physical interventions, research topics, and roles and responsibilities of all stakeholders. A multi-institutional and gender-sensitive FLMC of 5 (4 men and one woman) will be established and charged with the development of a community fallow land livestock development plan. The plans will be discussed and approved.  *Sub-activity RT3-Gh-4.1.2: Document policies and institutions on fallow land management:* Document current policies and institution/institutional arrangements governing control and access to fallow land resources. Analyze current policies that influence livestock mobility and fallow land utilization. Develop technical, institutional and policy options, integrated into a natural fallow land management scheme that would raise and sustain the production system.  *Sub-activity RT3-Gh-4.1.3: Characterize and conserve fallow land biodiversity:* Permanent monitoring sites will be established. Indigenous knowledge will be used to identify fallow land plant species essential for rehabilitation, livestock nutrition and health, and fuel wood production. Priority will be given to: key native species that are tolerant to drought, salinity and grazing; ethno-medicinal species, and under-utilized and dual-purpose species. The species will be collected and preserved. Seeds of the essential species will be collected and multiplied. Their biomass and seed production potential will be evaluated. Annual and seasonal net primary production and nutritive value will be quantified.  *Sub-activity RT3-Gh-4.4: Community actions to test and disseminate interventions to improve fallow land productivity and conserve the natural resource base:* Under the leadership of the FLMC, community-based workshops will be organized with farmers to discuss the socio-economic and environmental impact of fallow land degradation, to raise awareness and promote associative and community-based measures to restore overgrazed fallow land. Techniques for rehabilitation of degraded fallow land will be tested with farmers’ participation. These will include: technologies for mass seed production of target species at the community-level, water harvesting for crop and livestock production, reseeding using indigenous and introduced prominent species, establishment of leguminous shrub/tree plantations fodder banks, direct seeding, weed/brush control, grazing schemes to improve fallow land productivity, e.g., resting. Fallow land exclusion areas will be established. Protected sites will be compared with those that are continuously grazed. Total plant cover, composition of perennial species, biomass production and species richness will be monitored. Strategies to improve crop production from fallow lands will be explored. This will include improved fallow and keeping of livestock on fallow lands for manure. | | |  |  |  |  | | --- | --- | --- | | **Activity 5** | Testing options to increased feed from cropping systems | | | Lead Scientist(s) | Asamoah Larbi, Terry Ansah | Institution: IITA, UDS | | Other Scientist(s) | Terry Ansah, Bekele Hundie, Roland Kanlisi, Emmanuel Nartey, Peter Asongre | | | Students | Henry Alagma | | | Location(s) | Tibali, Duko, Botingli, Tibognayili, Cheyohi, Samboligo, Bonia, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | | | **Procedures** | | | | *Sub-activity RT3-Gh-5.1: Crop and livestock production from strip cropping systems.* The ILRI and IITA developed integrated crop-livestock option of 2 row sorghum: 4 rows of cowpea has not been widely scaled out in Ghana. Further, information is limited on using early millet instead of sorghum as the cereal crop. An on-farm trial will be conducted for sorghum and millet-based systems with the following treatment combination: 2 rows of cereal: 4 rows of legume and 2 rows of cereal to 2 rows of legume. The trials will be conducted for at least two seasons. Each sub-activity will be implemented with 10-20 households. For treatment with livestock, residues will be collected after harvesting and stored for dry season feeding of sheep and goats. Both biological (grain and fodder yields, weed diversity and biomass, soil chemical and physical properties, livestock weight gain and manure outputs) and socio-economic data will be collected. | | |   *Sub-activity RT3-Gh-5.2: Leaf stripping effects on grain and fodder yield*. The objective is to explore the possibilities of adjusting the cropping pattern to produce feed from thinning and leaf stripping. A split-plot design, replicated in 3-4 communities per region will be used. Maize planting density (5, 10 and 15 plants/m2) are main-plots, while no leaf-stripping, leaf-stripping after tassel ling and leaf-stripping after cob formation are sub-plots. The stripped leaves will be used as supplements to tethered piglets and kids. Cost-benefit analysis will be performed. Growth and yield of grain and stover; weed diversity and biomass; quality of the fodder; and weekly live-weight changes in the growing animals fed the fodder will be monitored.   |  | | --- | |  | | *Sub-activity RT3-Gh-5.3: Planting density of cowpea living mulch on maize fodder and grain yield and soil properties:* A split-split plot design replicated in 3-4 communities per region will be used to investigate the influence of land preparation method, grain legume live-mulch sowing density, and maize planting density on grain yield and the soil and water resources. Main-plots are land preparation method (no-till-kill vegetation with contact herbicide, hand-hoeing and plough), sub-plots are cowpea sowing density (0, 15 and 30 plants/m2) are maize planting density (recommended, higher rate). Growth and grain yield of maize, cowpea grain and biomass yield, weed biomass, surface run-off; soil physical (infiltration rate, porosity, temperature, bulk density), chemical (N, P, K), and biological (micro and macro fauna) properties will be recorded. Separate trials with the same treatments and procedure will be implemented using soybean and groundnut as legumes. | | *Sub-activity RT3-Gh-5.4: Sheep stocking density and agronomic management effects on grain yield, soil and vegetation cover in maize-based systems:* A split-split-plot design replicated in 3-4 communities per region will be used. Main-plots are no-corralling and corralling with sheep. Sub-plots are recommended (60kg/ha N-40kg/ha P2O5-40kg/ha K2O), medium (90kg/ha N-40kg/ha P2O5-40kg/ha K2O), and higher (120kg/ha N-40kg/ha P2O5-40kg/ha K2O) fertilizer rates, and sub-sub plots are recommended and higher maize planting density. Sub-sub plot size will be 4.5m x 5m (6-row plots). Maize will be spaced at 75cm between rows and 40cm within rows. Weed communities will be evaluated between 2-4 weeks after planting of cereal to determine number of weeds (density) and biomass to characterize species diversity. Grain and fodder yields and soil physical and chemical characteristics will be monitored. |   *Sub-activity RT3-Gh-5.5: Identification of food/feed crop varieties for grain and fodder production:* On-farm trials initiated in 2013 to identify high-yielding and better quality varieties/genotypes of cereals (maize, sorghum), and legumes (groundnut, cowpea, and soybean) for grain and fodder production will be continued. A trial initiated in 2014 on pigeon pea in collaboration with ICRISAT and Michigan State University will continue. A randomized complete block design replicated in 4-6 communities will be used. About 10-15 elite varieties/lines of each species will be compared in each trial. Fodder samples will be analyzed for quality Farmers’ field days will be organized to document farmers’ preferences. Multi-variate analysis using the yield and quality data will be used to identify clusters of varieties with potential for food (grain), feed (grain and stover), and feed (stover or crop residues) production. Seeds of promising species will be multiplied for dissemination. Grain and fodder yields, farmer preferences, fodder quality [(crude protein, CP; in vitro organic matter digestibility, IVOMD; neutral detergent fibre, NDF; acid detergent fibre, ADF)] will be documented.   |  |  |  | | --- | --- | --- | | **Activity RT3-Gh-6** | Strengthening institutional capacity for integrated crop-livestock research | | | Lead Scientist(s) | Asamoah Larbi | Institution: IITA | | Other Scientist(s) | Joel Sam | | | Partner(s) | IITA Biometric Unit, INSTI | | | Location(s) | Aburi and Bolga | | |  |  | | | **Procedures** |  | | | Integrated crop-livestock systems predominate in the cereal-legume based farming systems in West Africa. Yet most young researchers, especially women have limited skills in the design and implementation of integrated crop-livestock experiments. Two short-courses will be organized: 1) Experimental design and analysis using the Statistical Analysis Software (SAS) and 2) Integrated crop-livestock research design and analysis. The courses are follow-ups to similar courses organized in 2014.  *Sub-activity RT3-Gh-6.1: Organize a short-course on experimental design and data analysis:* A 10-day course will be organized in collaboration with the IITA Biometrics Unit. There will be 15-20 participants, 30% of whom will be women. The SAS software will be used for data analysis. There will be three components. Topics to be discussed under Component 1 (data collection) include: variables and measurements, types of scientific data and scientific data collection techniques. Component 2 (Data Management) will concentrate on: software and techniques for data entry and effective retrieval, detection of outliers or influential observations, exploratory/graphical data analysis. The third component (Data Analysis) will be on: categorical modeling of non-quantitative (continuous) response variables, and trend analysis, regression, time series, and prediction.  *Sub-activity RT3-Gh-6.2: Organize a short-course on integrated crop-livestock production:* A 5-day course will be organized for 10-15 participants. Topics to be covered include integrated crop-livestock systems, design of integrated crop-livestock experiments, and analysis and presentation of data from integrated crop-livestock experiments. | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **4. RT3-Gh activity schedule** | | | | | | | | | | | | | |  | *2014* | | | | *2015* | | | | *2016* | | | | | *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | | 1. Improve small ruminant production |  |  |  |  |  |  |  |  |  |  |  |  | | 2. Publish booklets on pig and poultry |  | x | x | X |  |  |  |  |  |  |  |  | | 3. Intensify pig and poultry production |  | x | x | X | x | X | x | x | x | x | x |  | | 4. Improve fallow lands |  | x | x | X | x | X | x | x | x | x | x |  | | 5. Improve feed from cropping |  | x | x | X | x | X | x | x | x | x | x |  | | 6. Living mulch for crop-livestock |  | x | x | X | x | X | x | x | x | x | x |  | | 7. Identify food feed crops |  | x | x | X | x | X | x | x | x | x | x |  | | 8. Build capacity for crop-livestock | x | x | x | X | x | X | x | x | x | x | x |  | |

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| **5. Research results/deliverables** | | **2014** | **2015** | **2016** |
| 1 | Reports and journal paper on improved small ruminant production | x | x | x |
| 2 | Two booklets on pig and poultry |  | x | x |
| 3 | Reports and two journal papers on rural pig and poultry production |  | x | x |
| 4 | Reports and a journal paper on improved fallow land management |  | x | x |
| 5 | Reports, a journal and a conference paper on integrated crop-livestock systems |  |  |  |
| 6 | Report and a journal paper on food/feed crops |  |  |  |
| 7 | Short-courses on integrated crop-livestock production for 100 researchers | x | x | x |

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| **6. Expected outcomes** | | Short | Medium | Long |
| 1 | More households keep their livestock under intensive management | x | x | x |
| 2 | Households have improved manure management |  | x | x |
| 3 | Farmers are adopting lamb fattening to capture niche markets |  | x | x |
| 4 | Village committees are managing fallow lands |  | x | x |
| 5 | Households are producing more feed from cropping systems | x | x |  |
| 6 | Researchers are implementing more integrated crop-livestock activities | x | x | x |
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| **7. 2015 Budget (US$)** | | |  |  |  |  | |  | |  | |
| Theme/Activity | | Budget line | ILRI | IITA | MOFA | SARI | | UDS | | KNUST | |
| RT3-Gh-1 | | Personnel | 72000 |  | 5000 |  | |  | |  | |
|  | | Services | 31000 |  | 3000 |  | |  | |  | |
|  | | Supplies | 29000 |  | 4000 |  | |  | |  | |
|  | | Travel | 18000 |  | 2000 |  | |  | |  | |
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| RT3-Gh-2 | | Personnel |  | 8000 | 5000 |  | | 5000 | |  | |
|  | | Services |  | 4000 | 4000 |  | | 4000 | |  | |
|  | | Supplies |  | 5000 | 4000 |  | | 4000 | |  | |
|  | | Travel |  | 4000 | 2000 |  | | 3000 | |  | |
|  | |  |  |  |  |  | |  | |  | |
| RT3-Gh-3 | | Personnel |  | 5000 | 5000 | 3000 | |  | | 5000 | |
|  | | Services |  | 4000 | 3000 | 0 | |  | | 4000 | |
|  | | Supplies |  | 4000 | 4000 | 3000 | |  | | 4000 | |
|  | | Travel |  | 3000 | 2000 | 2000 | |  | | 2000 | |
|  | |  |  |  |  |  | |  | |  | |
| RT3-Gh-4 | | Personnel |  | 8000 |  |  | |  | |  | |
|  | | Services |  | 4000 |  |  | |  | |  | |
|  | | Supplies |  | 4000 |  |  | |  | |  | |
|  | | Travel |  | 3000 |  |  | |  | |  | |
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| RT3-Gh-5 | | Personnel |  | 8000 |  |  | |  | | 5000 | |
|  | | Services |  | 4000 |  |  | |  | | 4000 | |
|  | | Supplies |  | 4000 |  |  | |  | | 4000 | |
|  | | Travel |  | 3000 |  |  | |  | | 2000 | |
|  | |  |  |  |  |  | |  | |  | |
| RT3-Gh-6 | | Personnel |  | 10000 |  |  | |  | |  | |
|  | | Services |  | 13000 |  |  | |  | |  | |
|  | | Supplies |  | 5000 |  |  | |  | |  | |
|  | | Travel |  | 10000 |  |  | |  | |  | |
|  | |  |  |  |  |  | |  | |  | |
|  | | Total | 150000 | 113000 | 43000 | 8000 | | 16000 | | 30000 | |
|  | | Grand total |  |  | 360000 |  | |  | |  | |

**Theme 4: Land, soil and water management (RT4-Gh)**

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| **1. Research team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Davie Kadyampakeni | IWMI | PhD | Soil and water | Leader, activity GT4-2 |
| Fred Kizito | CIAT | PhD | Soils, water and landscapes | Leader, activity GT4-1 |
| Wyndham-Wright T | IWMI | MSC | Extension | Communication |
| Pamela Katic | IWMI | PhD | Economics | Market links |
| Issahaku Jesiwuni | BADECC | - | Farm business | Farming organization |
| Emmanuel Obuobie | CSIR (WRI) | PhD | Hydrology | Water balance |
| Wilson Agyare | KNUST | PhD | Soil, crops, agronomy | Trials on activities 1-4 |
| Francis Tetteh | SRI | PhD | Soil, crops, agronomy | Soil science |
| Emmanuel Panyan | ARI | PhD | Soil, crops, agronomy | Agronomic expertise |
| Elias Salifu | KNUST | BSc | Soil water management | Graduate student |
| Asamoah Larbi | IITA | PhD | Crop, livestock | Leader, activity GT4-3 |

**2. Objectives**

The main objective in this work-package is to improve water management practices for crop-livestock production systems of northern Ghana. Specifically, this component will:

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| 1 | Test small-scale irrigation technologies for dry season vegetable production |
| 2 | Test water management practices to improve productivity in rainfed crop-livestock systems |
| 3 | Prepare and disseminate knowledge materials to end users |
| 4 | Evaluate options to improve land and soil management |
| 5 | Draft and submit 2-3 journal papers – December 2015 |
| 6 | Monitor, implement and demonstrate best-bet on-farm soil and land conservation interventions for improved soil and nutrient retention. |
| 7 | Provide farmer recommendation and conduct trade-off analysis and scenario generation for soil and land restoration strategies that highlight associated economics of land degradation and restoration management. |

**3. Activities and work plans**

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| **Activity RT4-Gh-1** | Testing small-scale irrigation options for dry season vegetable[[1]](#footnote-1) production | |
| Lead Scientist(s) | Davie Kadyampakeni | Institution: IWMI |
| Other Scientist(s) | Pamela Katic | |
| Location(s) | Duko, Samboligo, Bonia, Nyangua in the Northern and Upper East Regions | |
| Other Partners | Asamoah Larbi, Jean-baptiste Tignegre Wilson Agyare, Issahaku Jesuwuni | |
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| **Procedures** | | |
| Irrigation management is critical for sustainable crop production particularly in the dry season. The following sub-activities will be implemented and will be linked to the ILSSI project in one of the selected sites.  *Sub-activity RT4-Gh-1.1.* *Site/Watershed characterization*: This will involve delineation of the selected watershed and sites, documenting long-term rainfall trends, quantifying of surface and groundwater resources and other biophysical elements of relevance to irrigation.  *Sub-activity**RT4-Gh-1.2. Participatory evaluation of water lifting and water delivery methods for vegetable production:* Various water lifting and conveyance technologies will be compared with regards to water productivity, labor and cost requirements for the dry season vegetable production. The following water lifting and delivery technologies will be implemented:   * Water lifting technologies: i) motorized pumps, ii) solar pumps, and iii) water cans/buckets; * Water application methods: i) drip, ii) furrow, iii) overhead tank with a hose and iv) bucket irrigation.   *Sub-activity RT4-Gh-1.3. Assessment of irrigation frequency and amount using different irrigation scheduling methods:* A simple tool (sensor –based) will be tested to assist farmers in the irrigation scheduling of vegetables. The tool indicates when the root-zone is dry and when it becomes saturated during irrigation. The water productivity and overall irrigation application rates using the sensors will be compared against: i) a fixed irrigation schedule and ii) the farmers’ normal practice. The assessment on farmers’ fields will include appropriate nutrient and pest management practices and it will provide an opportunity for farmers to compare the tested irrigation scheduling methods with respect to water, labor and time savings. This will also provide the framework for farmers to judiciously optimize irrigation management in water scarce environments.  *Sub-activity RT4-Gh-1.4. Socio-economic analysis of water management interventions for dry season vegetable production:* The interventions listed in the sub-activities RT4-Gh-1.2 and RT4-Gh.1.3 and A3 above will be analyzed in terms of adoption potential, labor productivity, costs and benefits, business models for successful interventions and market potential for produced vegetables. Special attention will be given to understanding the adoption potential, constraints and benefits to men, women and youth in the farming communities. | | |

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| **Activity RT4-Gh-2** | Improving water productivity in rainfed crop-livestock production system | |
| Lead scientist(s) | Davie Kadyampakeni | Institution: IWMI |
| Other scientist | Pamela Katic | |
| Location(s) | Upper East and Upper West project sites | |
| Other Partners | Asamoah Larbi; Emmanuel Panyan , Wilson Agyare, Issahaku Jesuwuni | |
|  |  | |
| **Procedures** | | |
| The rainfed crop-livestock production system requires demonstration of effective water management interventions to enhance productivity. In particular, forage production is often affected by rainfall irregularities and is actually scarce during the dry season. This activity component will explore with farmers, the potential for adopting irrigated forage production in Ghana. The following sub-activities will be implemented.  *Sub-activity RT4-Gh-2.1: Exploring the potential for forage irrigation in Northern Ghana:* The potential for forage production through irrigation in northern Ghana would be investigated through literature review and questionnaire surveys. It will cover the: 1) potential for adoption of forage irrigation by male and female farmers and 2) market opportunities for forage and the added value of forage irrigation to the livestock value chain during the dry season.  *Sub-activity RT4-Gh-2.2: Piloting supplementary irrigation for forage production:* Under supplementary irrigation, forage crops will be produced and differentiated for different types of fodder crops, leguminous vs. non-leguminous fodder. About 5 to 15 farmers will be identified to pilot the production of folder under supplementary irrigation.   |  |  |  | | --- | --- | --- | | **Activity RT4-Gh-3** | Piloting improved combinations of soil and land management strategies on-farm | | | Lead Scientist(s) | Fred Kizito | Institution: CIAT | | Other scientist(s) | Davie Kadyampakeni, Wilson Agyare, Francis Tetteh and Emmanuel Panyan | | | Location (s) | Duko, Samboligo, Bonia, Nangua | | |  | | | | **Procedures** | | | | Evaluation of the farming landscapes in 2013 revealed that there has been substantial transition of the farming systems and land use patterns. This has taken place alongside other drivers such as low and erratic rainfall and poor land management practices. In order to provide viable interventions and recommendations, we propose piloting of on-farm trials to address erosion prevalence and land degradation that will in turn increase crop productivity through three sub-activities outlined below:  *Sub-activity GT4-3.1: Establish land and soil conservation structure on-farm land*: This will entail establishment of tied-ridges, cover crops and contour cropping compared against farmer practices. It will involve prior consultation with other work packages as well as target farmers involved.  *Sub-activity GT4-3.2: Monitor soil losses, nutrient movements and soil moisture variation*. To provide evidence for sub-activity 1.1;   * Soil losses will be monitored by a modified version of runoff soil loss detectors that captures 75% of the plot runoff zone; * Nutrient dynamics will be monitored using suction lysimeters which will be held at a tension of 70 cbars and installed at varying depths along the profiles of interest in order to ascertain fate and transport as well as verify what percentage is captured within the crop root zone; * Soil moisture will provide vital links to both soil and nutrient losses. Soil moisture will be monitored using a diviner probe (Sentenk Inc.) to depths of 1.6 m at 10 cm increments within the profile. Access tubes for moisture measurement with the diviner probe will be installed in the center position of the target plots. | | |   *Sub-activity GT4-3.3: Evaluate effectiveness of land and soil conservation structures towards mitigating soil losses, nutrient losses and soil moisture conservation*. This will entail conducting a detailed analysis of the spatial and temporal trends of the data collected through monitoring in sub-activity 1.2. Essentially, the assessment will include evaluation of soil conservation practices (both structural and vegetative) towards environmental integrity (allowing moisture infiltration, reducing erosion and nutrient losses). | | |

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| **Activity RT4-Gh-4** | Farmer recommendations, tradeoff analysis and scenario generation for land restoration strategies | |
| Lead Scientist(s) | Fred Kizito | Institution: CIAT |
| Other scientist(s) | Wilson Agyare, Francis Tetteh and Emmanuel Panyan | |
| Location (s) | Duko, Samboligo, Bonia, Nangua | |
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| **Procedures** | | |
| *Sub-activity GT4-4.1: Economics of farm productivity in the context of soil conservation measures*: This will involve: conducting economics of farm productivity that incorporate labor and level of effort for land and soil conservation measures; quantifying losses associated for the lack of action (would use on-farm counter-factual results); and quantify (monetary and non-monetary) the benefits of action associated with interventions.  *Sub-activity GT4-4.2: Farmer recommendations, tradeoff analysis and scenario generation*. This consists of : simple farmer-tailored recommendations that communicate key recommendations; a web-based interface for the research community, policy makers and implementing NGOs on key findings; and overall synthesis for trade-off matrix and scenario generation based on above sub-bullets. | | |

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| **Activity RT4-Gh-5** | Evaluating intensified and diversified crop-livestock farming in a watershed | |
| Lead Scientist(s) | Asamoah Larbi, Davie Kadyampakeni | Institution: IITA, IWMI |
| Other Scientist(s) | William Agyare, Fred Kizto | |
| Consultant(s) | To be identified | |
| Student | To be identified | |
| Location(s) | Samboligo, Bonia, Nyangua | |
|  |  | |
| Procedures |  | |
| *Sub-activity RT4-Gh-5.1:* *Select and characterize watershed:* At least one representative watershed will be identified and characterized in each region based on: (i) being representative of biophysical and socioeconomic variability of the target areas, (ii) rainfed farming/livestock production is practiced at the sites, (iii) easily accessible and central to a large number of farming communities, (iv) farmers are interested in the project and willing to provide their land, and (v) having the major problems within the watershed that need solution. This activity is integrated to activities RT4-Gh-1 and RT4-Gh-2.  *Sub-activity RT4-Gh-5.2: Initiate integrated research cutting across all themes:* Where appropriate, and based on existing indigenous knowledge of water use, test options for micro-catchment water harvesting, use of contour bunds, etc., that improve on traditional water harvesting methods, and test options for utilizing water more efficiently in irrigated crop (cereal, legume, vegetable, fodder) and livestock production. Possible experiments will include:   * Compare small scale irrigation practices for intensive crop-livestock production * Compare small-scale irrigation practices for dry season vegetable production. * Monitoring nutrient losses with natural runoff under different crop covers. * Minimizing surface run-off and conservation of moisture through strip cropping. * Compare tillage practices with cover crops for conservation of soil and moisture. * Study the efficiency of various vegetative and physical structures to control erosion | | |

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| **4. Theme RT4-Gh activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Test small-skill irrigation options |  | x | x | x | x | X |  |  |  |  |  |  |
| 2. Improve rain-fed water productivity | x | x | x | x | x | X | x | x | x | x |  |  |
| 3. Improve watershed productivity |  |  |  |  | x | X | x | x | x | x | x |  |

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| **5. Expected results/deliverables (1-4 by IWMI; 5-8 by CIAT)** | | 2014 | 2015 | 2016 |
| 1 | Two journal papers on water management | x | x | x |
| 2 | Technical report on water management | x | x | x |
| 3 | Guidelines for agricultural water management for vegetables |  | x | x |
| 4 | Two MSc dissertations |  |  | x |
| 5 | Report on trade-off analysis and scenario generation for optimal systems productivity and restoration measures decisions. |  | x | x |
| 6 | Field protocols on soil and land conservation measures developed |  | x |  |
| 7 | Web-based interface developed for dissemination |  | x |  |
| 8 | Publish a journal article in June 2015 and draft another in December 2015. |  | x | x |

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| **6. Expected outcomes** | | Short | Medium | Long |
| 1 | Households are adopting improved water, soil and land management |  | x | x |
| 2 | More households are harvesting water for dry season vegetable production | x | x | x |

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| **7. 2015 Budget (US$)** | |  |  |  |  |
| Theme/Activity | Budget line | IWMI | CIAT | IITA | KNUST |
| RT4-Gh-1 | Personnel | 40000 |  |  |  |
|  | Services | 10000 |  |  |  |
|  | Supplies | 16000 |  |  |  |
|  | Travel | 5000 |  |  |  |
|  |  |  |  |  |  |
| RT4-Gh-2 | Personnel | 28000 |  |  |  |
|  | Services | 10000 |  |  |  |
|  | Supplies | 11000 |  |  |  |
|  | Travel | 5000 |  |  |  |
|  |  |  |  |  |  |
| RT4-Gh-3 | Personnel |  | 36000 |  |  |
|  | Services |  | 7000 |  |  |
|  | Supplies |  | 9700 |  |  |
|  | Travel |  | 2000 |  |  |
|  |  |  |  |  |  |
| RT4-Gh-4 | Personnel |  | 27000 |  |  |
|  | Services |  | 5500 |  |  |
|  | Supplies |  | 8000 |  |  |
|  | Travel |  | 4800 |  |  |
|  |  |  |  |  |  |
| RT4-Gh-5 | Personnel |  |  | 16000 | 8000 |
|  | Services |  |  | 8000 | 4000 |
|  | Supplies |  |  | 12000 | 6000 |
|  | Travel |  |  | 4000 | 2000 |
|  |  |  |  |  |  |
|  | Total | 125000 | 100000 | 40000 | 20000 |
|  | Grand total |  | 285000 |  |  |

**Theme 5: Nutrition, food storage, value addition and mycotoxin management (RT5-Gh)**

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| **1. Research team** |  |  |  |  |
| Name | Institution | Degree | Research interest | Role |
| Mahama Saaka | UDS | PhD | Public health nutrition | Leader, RT5-Gh-1 |
| Sofo Mutaru | GHS | MSc | Community nutrition | Training women |
| Jacob Mahama | GHS | MPh | Public nutrition | Capacity building |
| Bridget Parwar | WIAD | MSc | Community nutrition | Training women |
| Chrisantus Daari | GHS | MSc | Community nutrition | Training caregivers |
| Gloria Kobati | GHS | MSc | Community nutrition | Training caregivers |
| Adebayo Abbas | IITA | PhD | Post-harvest management | Leader, RT5-Gh-2 |
| Asamoah Larbi | IITA | PhD | Crop-livestock systems | Coordination |
| Ranajit B | IITA | PhD | Mycotoxin management | Guidance |
| Joseph Atehnkeng | IITA | PhD | Mycotoxin management | Leader, RT5-Gh-4 |
| George Opit | PHL-ILs | PhD | **Pest Management** | PHL-ILs contact |
| Francis Appiah | KNUST | PhD | Food technology | Leader, RT5-Gh-3 |
| Daniel Agbetiameh | KNUST | MSC | Mycotoxin management | PhD student |
| Richard T. Awuah | KNUST | PhD | Mycotoxin management | Guidance/Consultant |
| Post-Harvest Losses Innovation Lab (PHL-ILs), Oklahoma State University | | | | |

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| **2. Objectives** | |
| 1 | Publish results of completed household nutrition studies. |
| 2 | Determine nutritional status of caregivers, women of childbearing age and their children less than 60 months in target communities. |
| 3 | Conduct awareness campaigns to improve knowledge on better household nutrition and the menace of aflatoxin to human health, animal productivity and trade. |
| 4 | Demonstrate preparation of recipes from local food types. |
| 5 | Compare options to improve nutritional status of households at the intervention communities |
| 6 | Determine the nutritional and anti-nutritional characteristics of cereal and legume-based food products as consumed in the target communities. |
| 7 | Introduce and test the acceptability of nutritionally enhanced crops and vegetables. |
| 8 | Conduct studies on effect of traditional processing methods on nutrient retention and bioavailability. |
| 9 | Introduce, evaluate and promote technologies to reduce post-harvest losses in stored cereal and legume grains at the household and community levels. |
| 10 | Introduce, evaluate and promote labor saving devices for value additions/processing. |
| 11 | Test the efficacy of atoxigenic strains of *Aspergillus flavus* as bio pesticides to reduce aflatoxin levels under farm conditions. |
| 12 | Conduct training of trainers workshops on improved soybean and cowpea processing, product development and food hygiene/safety. |
| 13 | Build capacity individual (MSc and PhD) and institutional capacity for research on post-harvest losses and value addition. |

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| **3. Activities and work plans** | | |
| **Activity RT5-Gh-1** | Improve household nutrition | |
| Lead Scientists(s) | Mahama Saaka | Institution(s): UDS |
| Other Scientist(s) | Mahma Saaka, Caroline Seigbou, Mary Glover, Asamoah Larbi, Chrisantus Daari, Gloria Kobati, Sofo Mutaru, Bridget Parwar, Mary Paula Kogana | |
| Consultant | To be identified | |
| Location(s) | Intervention communities in the three regions | |
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| *Sub-activity RT5-Gh-1.1: Expert workshop to organize cross-country activities*. An expert workshop involving the nutrition teams in Ghana and Mali will be organized by March 2015 to explore joint activities on linking improving household nutrition through agriculture and behavioral change. Key activities will be identified. A committee will be set up to oversee the implementation of the planned activities and promote cross-country learning.  *Sub-activity RT5-Gh-1.2: Publish results of the nutrition baseline survey.* Two baseline nutrition surveys were conducted in the Africa RISING intervention communities by UDS and FRI in 2013. Data were analyzed and draft reports prepared. A consultant has been hired to summarize the UDS data into a booklet. Another consultant will be hire to analyze and prepare a booklet based on the data from the FRI survey. Papers under review in peer reviewed journals will be revised after editorial comments. Draft papers will be finalized and submitted for publication. | | |
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| *Sub-activity RT5-Gh-1.3: Improve nutritional knowledge of women:* About 200 pregnant women and nursing mothers with children under 24 months in each region will be trained in improved nutrition and health to adopt appropriate nutrition practices. The training will cover the importance of diversifying diets, nutrition during pregnancy, early and exclusive breast feeding, the appropriate quantity and quality of complementary foods, and preventive healthcare services, such as antenatal care behaviors. Cooking demonstration sessions at the community level will be organized to train mothers and women on the preparation of appropriate recipes using locally available food types. | | |
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| *Sub-activity RT5-Gh-1.4: Comparison of strategies for improving household nutrition:* A 400-600 households with women and nursing mothers with children aged 6-36 months will be randomly selected from the 25 intervention communities. At least 50 households will be randomly assigned to one of the following treatments:  1. Behavior change communication training every month (BCC).  2. Agriculture-based household nutrition improvement (ABN).  3. A combination of BCC and ABN (BCC + ABN).  The BCC training will be offered by community and health and nutrition workers, and members of the women’s groups in the intervention communities who have been trained BCC in nutrition and health. This will equip the women, lactating mothers with children below 5 years and pregnant women, to adopt proper health care and nutritional practices. Community-based growth and monitoring promotion (CBGMP) will be established in the participating communities for bio-monthly weighing of children under 5 year.  Households on the ABN will be given training in vegetables, legumes (cowpea, soybean, and groundnut) and sheep, goat and poultry production. They will be given support in the production and management of the crops and animals.  A cluster non-randomized controlled trial will be used to collect quantitative primary data from mother/child pairs. This means **a controlled** pre-test/post-test design involving two cross-sectional surveys at baseline and end point follow-up will be used to determine the outcome/impact of the program. **This will involve making** observations before and after the implementation of an intervention, both in the communities that receive the intervention and in comparison communities. Surveys will be conducted to document diet diversity and farmer perception. | | |

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| **Activity RT5-Gh-2** | Reducing post-harvest losses in stored grains of cereals and legumes | |
| Lead scientists(s) | Abass Adebay | Institution: IITA |
| Other scientist(s) | Issa Sugri, George Opti, Bekele Kuto, Asamoah Larbi | |
| Student (s) | To be identified | |
| Location(s) | Tibali, Duko, Tibognayili, Cheyohi, Samboligo, Bonia, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | |
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| **Procedures** | | |
| On-farm trials will be conducted to evaluate, adapt and disseminate storage technologies to reduce post-harvest losses in stored-grain, especially maize, groundnut and cowpea.  The activities will be undertaken in collaboration with the Post-harvest Losses Innovation Laboratory, which will provide expertise in entomology, facilitate pilot-testing of a low-cost moisture meter, monitoring aflatoxin levels and research in drying technologies. A letter of intent will be signed with GrainPro to evaluate, adapt and demonstrate some of their products in graduate student’s dissertation research work.  Most of the on-farm studies will use a randomized complete block design (RCBD) with communities as blocks and households as replicates, and farmers’ current practices as controls. The trials will be conducted in 6 communities with 10-20 households per treatment based on the size of the community. The trials will be conducted over 12-18 months. Data to be collected every two months will include: pest infestation, volume per weight loss, quality losses (physical, bio chemical, nutritional, economic), aflatoxin levels and farmers’ perceptions.  *Sub-activity RT5-Gh-2.1: On-farm comparison of storage technologies to prevent stored-product insect infestation of maize:* Treatments will include:  1. Atelic-treated maize in 50 kg polyethylene bags (poly sacks)  2. Untreated maize in 50 kg polypropylene (PP) bags and  3. Untreated maize in 50 kg deltamethrin (DM) incorporated polypropylene VF ZeroFly bags  4. Untreated maize in 50 kg Super Grain Bags (GrainPro)  5. Untreated maize in 50 kg PICS bags | | |
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| *Sub-activity RT5-Gh-2.2: On-farm evaluation and demonstration of silos for grain storage:* The study will be conducted over a period of 12-16 months with the following treatments:  1. Farmer’s silo  2. Modified farmer’s silo  3. 1-ton GS4 Silo bags | | |
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| *Sub-sub-activity RT5-Gh-2.3: Effect of jute and PIC sacks and grain protectants on maize and cowpea losses on-farm*: Treatments:  1. Jute sack  2. PICS bag  3. GS4 sacks  4. Jute sack + protectant  5. PICS bag + protectant  6. GS4 sack + protectant  For each treatment, 50kg of maize and 50kg of cowpea will be stored in jute, PICS and GS4 sacs with or without grain protectants. Two commonly used grain protectants, Actellic Super EC and phostoxin were applied at the recommended rates. Actellic Super EC is a food-grade chemical containing 80g pirimiphos-methyl and 15g permithrin/liter as emulsifiable concentrate. The application dose provided by the manufacturer is 300ml in 15l of water for 20 maxi bags of maize. Post-harvest losses will be monitored over a period of 12 months. | | |
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| *Sub-activity RT5-Gh-2.4: Potential of hermetic plastic containers to reduce post-harvest losses on farm:* The effect of hermitic plastic tanks with or without grain protectants (Actellic Super EC and phostoxin) on post-harvest losses in maize and cowpea will be evaluated using the following treatments:  1. Round plastic container (RPC) only  2. RPC + Actellic Super EC  3. RPC + Phostoxin  For each treatment, 50kg of maize and 50kg of cowpea will be either stored in hermitic tanks with or without grain protectants.  *Sub-sub-activity RT5-Gh-2.4: Evaluate, adapt and disseminate GrainPro products*: Sign a letter of intent with GrainPro representative in West Africa to evaluate and demonstrate some of their products. GrainPro will provide the products which will be used for on-farm demonstrations in the Africa RISING intervention communities to compare the new products with farmers’ practices. Potential products to be evaluated include:  1. Super Grain Bags (SGB IV-R)  2. Collapsible Dryer Case  3. Silbags. | | |

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| **Activity RT5-Gh-3** | Develop and test new food products/blends from major crops and livestock: | |
| Lead scientists(s) | Francis Appiah | Institution: KNUST |
| Other scientist(s) | Alhaji Mahama | |
| Student (s) | Martha Agyiri | |
| Location(s) | Tibali, Duko, Tibognayili, Cheyohi, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | |
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| **Procedures** | | |
| *Sub-activity RT5-Gh-3.1: Developing breakfast meals and infant formulae.* Different breakfast meals and infant formulae will be tested as part of an MSc. Dissertation research. This includes millet based (Hausa koko flour) and Fula (Soyamilk/groundnuts). Experiment 1 will compare solar and sun drying effects on the following treatments/levels of substitution: 1. 100% millet, 2) 95% millet + 5% groundnut, 3) 90% millet + 10% groundnut, 4) 85% millet + 15% groundnut and 5) 80% millet + 20% groundnut. Treatments for Experiment 2 are: 1. 100% fulla, 2) 95% fulla + 5% soya milk (SM), 3) 90% fulla + 10% SM, 4) 85% fulla + 15% SM and 5) 80% fulla + 20% SM. Data to be collected include: sensory evaluation, consumer acceptance, proximate composition (mineral, vitamins), shelf live studies, storage pest, microbiological quality and packaging.  *Sub-activity RT5-Gh-3.2: Training women in food product development.* The Women in Agricultural Development Unit of the Ministry of Food and Agriculture will continue training of women in the intervention communities’ food processing, especially processing of legumes such as soybean into products such as soybean milk and other products. | | |

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| **Activity RT5-Gh-4** | **Biological control of aflatoxins in maize and groundnut with aflasafe GH01** | |
| Scientist(s) | Joseph Atehnkeng | Institution: IITA, KNUST |
| Other scientist(s) | Ranajit Bandyopadhyay | |
| Consultant | Richard.T. Awuah | |
| Student(s) | Daniel Agbetiameh | |
| Location(s) | Tibali, Duko, Tibognayili, Cheyohi, Samboligo, Bonia, Nangua, Zanko, Guo, Passe, Goli, Nato-Douri | |
| **Procedures** | | |
| *Sub-activity RT5-Gh-4.1: Training of farmers and extension agencies.* A stakeholder sensitization meeting will be held for regional, district directors of MoFA and SARI in all the three regions (Northern, Upper West and Upper East) to update them on the progress of work done in their regions and districts and to brainstorm on more effective and collaborative approach of their staff in curbing the aflatoxin menace through biological control and other best farm and storage practices. Further, three awareness and sensitization workshops (one in each region) will be conducted for farmers and AEAs of MoFA to highlight aflatoxins as a problem, its causes (how, where and affected crops), signs and symptoms on crops, effects on human and animal health as well as trade, management strategies with focus on biological control, etc. Farmers, consumers, staff of MoFA and regulatory agencies will be sensitized about the potential of bio control for producing maize and groundnut with acceptable levels of aflatoxins. Key resource persons from IITA bio control team, the KNUST, FRI and MoFA with expertise in the field of aflatoxin research will be invited to make presentations. As far as possible, awareness and training activities of this work package will be linked to those by Feed the Future Innovation Lab on Post-harvest Loss reduction. A total of 9 comprising, 3 regional and 6 district directors of agriculture will be sensitized. In addition, 200 farmers and at least, 12 AEAs will also be invited to the workshops. Focus group discussions on the topic will also be held at the community level. In the Northern Region, group discussions will be organized in Duko, Savelugu District and Tibognayili and Banjoing in Tolon- District. In the Upper West Region group discussions will be organized in Passe, Zanko in Wa West District and Natoduori and Goli in the Nadowli District. While in Upper East Region, group discussions will be organized in Samboligo in Bongo District and Nyangua, Gia and Tekuru in Kassena-Nankana District. A list of all participants in each meeting will be made and leaflets on aflatoxin biocontrol and other methods of aflatoxin management will be distributed to participants. Panel discussions will also be held on local and national FM radio and television stations with farmers and other stakeholders pre-informed through text messages on phone about such programs. We will also try to coordinate this activity with ICRISAT that is working on aflatoxin management in groundnut in Africa RISING project. | | |
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| *Sub-activity RT5-Gh-4.2: Field efficacy trials for pre-registration of atoxigenic strains of Aspergillus flavus as bio pesticides:* Farmers and/or farmer associations and sites for on-farm efficacy evaluation of the biocontrol agent will be identified and selected from the AR focus communities. A total of 180 fields comprising 90 treated maize fields with 30 fields per region and 90 groundnut fields with 30 fields per region. For each treated field an untreated field will be identified to serve as control. Field sizes will range between 0.3 ha – 1 ha and separated from control fields by at least 50 m. Each field will be considered a replicate. The trials will be conducted on crops grown by farmers as per their normal agronomic practices. Farmers will be sensitized and trained on when to apply and mode of application of the biocontrol agent, as well as, how it works to reduce aflatoxins in crops. Field soils samples will be collected prior to application of the biocontrol agent to measure the native population structure of *A. flavus* and after harvesting to measure the changes in the *Aspergillus* community structure due to biocontrol product application. Further, crop (grain) samples will also be collected to conduct laboratory analysis on the efficacy of the biocontrol products. This procedure will be carried out for at least two successive growing seasons. Field efficacy data collected will be used to satisfy requirements for pre-registration of the biocontrol agent as a biopesticide.  Further, the frequency of application of aflasafe GH01 will be determined in a carry-over experiment over 3 consecutive growing seasons in the Northern region using farmer’s fields. Fifty maize or groundnut fields will be selected. These will be sub-divided into 5 treatment of 10 fields each. In treatment 1, fields will be treated in alternate years with aflasafe GH01 within the period of the experiment. In treatment 2, fields will be inoculated consecutively in all three growing seasons. Fields in treatment 3 will be inoculated only in the first and second growing season while in treatment 4 inoculation will be carried out only in the first growing season. Fields in block 5 will serve as control with none of the fields inoculated throughout the study period. Again, field soil samples and crop samples will be collected in each growing season for microbial and, or chemical analysis on grain samples.  In addition to the 90 fields in the Africa RISING areas in northern Ghana mentioned above (funded by Africa RISING), efficacy trials will be also conducted in the middle belt (funded by another complementary project – the Meridian/PACA/BMGF regional biocontrol development). The country-wide efficacy trials are required to determine the efficacy of biocontrol in several agro-ecozones. | | |

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| **4. Theme MT5 activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Improve household nutrition | x | x | x | x | x | x | x | x | x | x | x | x |
| 2. Comparison of storage methods |  |  |  |  |  | x | x | x | x | x | x | x |
| 3. Product development and training women |  |  | x | x | x | x | x | x | x | x | x | x |
| 4. Development of aflasafe GH01 |  | x | x | x | x | x | x | x | x | x | x | x |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5. Expected results/deliverables** | | **2014** | **2015** | **2016** |
| 1 | A joint Ghana-Mali nutrition teams workshop report |  | x |  |
| 2 | A booklet on household nutrition |  | x |  |
| 3 | At least two papers drafted and submitted | x |  |  |
| 4 | At least 300 community health and nutrition staff trained | x | x | x |
| 5 | A report on strategies to improve household nutrition |  |  | x |
| 6 | Report on best practices for reducing stored-grain losses |  | x | x |
| 7 | Report on farmers’ awareness of aflatoxins as a food safety concern |  | x | x |
| 8 | Weekly radio and television messages on effects of aflatoxins |  | x | x |
| 9 | Results of efficacy trials in farmers’ fields |  | x | x |
| 10 | Data available for pre-registration of atoxigenic strains as bio pesticides |  |  | x |
| 11 | An aflatoxin biocontrol product, GH01 registered in Ghana |  |  | x |
| 12 | A report on strategies to improve household nutrition |  |  | x |
| 13 | Breakfast meal formulae for infants available and tested with caregivers |  | x |  |
| 14 | Student dissertation (3 MSc) |  | x |  |

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| --- | --- | --- | --- | --- |
| **6. Expected outcomes** | | 2014 | 2015 | 2016 |
| 1 | Households are adopting behaviors to improve dietary diversity | x | x | x |
| 2 | Caregivers/women apply their nutritional skills in food preparation | x | x | x |
| 3 | Households adapt technologies that reduce post-harvest losses |  | x | x |
| 4 | Extension officers have included aflatoxin management in their messages |  |  | x |
| 5 | Households have adopted measures to reduce aflatoxin in maize and groundnut |  | x |  |

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| **7. 2015 Budget (US$)** | | | | | |  |
| Activity | Budget Line | UDS | GHS | MoFA | IITA | KNUST |
| GT5-1 | Personnel | 5000 | 5000 | 5000 |  |  |
|  | Services | 5000 | 7000 | 7000 |  |  |
|  | Supplies | 8000 | 4000 | 4000 |  |  |
|  | Travel | 2000 | 4000 | 4000 |  |  |
|  |  |  |  |  |  |  |
| GT5-2 | Personnel |  |  |  | 50,000 |  |
|  | Services |  |  |  | 10,000 |  |
|  | Supplies |  |  |  | 40,000 |  |
|  | Travel |  |  |  | 10,000 |  |
|  |  |  |  |  |  |  |
| GT5-3 | Personnel |  |  |  |  | 4000 |
|  | Services |  |  |  |  | 2000 |
|  | Supplies |  |  |  |  | 3000 |
|  | Travel |  |  |  |  | 1000 |
|  |  |  |  |  |  |  |
| GT5-4 | Personnel |  |  |  | 38000 |  |
|  | Services |  |  |  | 13000 |  |
|  | Supplies |  |  |  | 10000 |  |
|  | Travel |  |  |  | 14000 |  |
|  |  |  |  |  |  |  |
|  | Total | **20000** | **20000** | **20000** | **185000** | **10000** |
|  | Grand total |  | 255000 |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- |
| **2015 consolidated budget (US$) for Ghana** | | | | | | |
|  | Research Theme1,2,3,4,5 | | | | | |
| Partner | 1 | 2 | 3 | 4 | 5 | Total |
| AVRDC |  | 130 |  |  |  | **130** |
| CIAT |  |  |  | 100 |  | **100** |
| GHS |  |  |  |  | 206 | **20** |
| ILRI |  |  | 150 |  |  | **150** |
| IWMI |  |  |  | 125 |  | **125** |
| IITA | 140 | 195 | 113 | 40 | 185 | **673** |
| KNUST |  | 30 | 30 | 20 | 10 | **90** |
| MOFA | 446 | 296 | 436 |  | 206 | **136** |
| SARI |  | 52 | 8 |  |  | **60** |
| UEA | 70 |  |  |  |  | **70** |
| UDS |  | 107 | 167 |  | 20 | **46** |
| Total | **254** | **446** | **360** | **285** | **255** |  |
| Grand total |  |  | **1600** |  |  |  |
| 1Partnerships and socio-economics assessment (Research Theme 1). | | | | | | |
| 2 Intensification of cereal-legume-vegetable cropping (Research Theme 2). | | | | | | |
| 3 Intensive livestock and integrated crop-livestock production (Research Theme 3). | | | | | | |
| 4 Land, soil and water management (Research Theme 4). | | | | | | |
| 5 Improving nutrition, food storage, value addition and mycotoxin management (Research Theme 5). | | | | | | |
| 6Funds held by IITA for GHS (training women on Behavioral Change Communication and best household nutrition practices) and MOFA (monthly fuel allowance for agricultural extension agents and veterinary services). | | | | | | |
| 7Funds held by IITA to pay monthly stipend of graduate students registered at KNUST and UDS who are based with the Africa RISING regional teams for their dissertation research. | | | | | | |

**3. Mali work-plans and budget**

**Theme 1: Partnerships and socio-economics of intensification (RT1-Ma)**

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| --- | --- | --- | --- | --- |
| **1.** **Research Team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Joachim Binam | ICRAF | PhD | Policy | Leader, activity RT1-Ma-1 |
| Bougouna Sogoba | AMEDD | MSc | Rural development | Deputy leader, RT1-Ma-1 |
| Birhanu Zemadim | ICRISAT | PhD | Land/Water management | Coordination |
| Bekele Kotu | IITA | PhD | Agricultural economics | Leader activity RT1-Ma-1.2 |
| Abdoulaye Diakite | MOBIOM | MSc | Training | Monitor meetings |
| Eva Weltzien | ICRISAT | PhD | Sorghum breeding | Seed systems |
| Gatien Falconnier | ICRISAT | MSc | Farming systems | Managing trial |
| Catherine Dembele | ICRAF | PhD | Agroforestry | Managing trials |
| Ousmane Sanogo | IER | PhD | Farming systems | Markets |
| Katrien Descheemaeker | WUR | PhD | Farming systems | Farming systems |
| Mary Ollenburger | WUR | MSc | Farming systems | Managing trials |
| Mulubirhanu Amare | ICRISAT | PhD | Agricultural economics | Socio-economic studies |
| Ousman Sanogo | IER | PhD | Agricultural economics | Market study |

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| **2. Objectives** | | | | |
| 1 | Establish and inaugurate district-level research-for-development (R4D) platforms. | | | |
| 2 | Conduct a stakeholder analysis to analyze existing stakeholders and their interests. | | | |
| 3 | Strengthen capacity of stakeholders on innovation system approaches. | | | |
| 4 | Identify and validate different stakeholders and their potential roles in the R4D. | | | |
|  | | | | |
| **3. Activities/workplans** | | | | |
|  | | | | |
| **Activity RT1-Ma-1** | | Establishment and characterization of R4D Platforms | | |
| Lead Scientists(s) | | Joachim Binam | Institution: ICRAF | |
| Other scientist(s) | | Bougouna Sogoba | | |
| Location(s) | | Bougouni and Koutiala/Yanfolila districts | | |
|  | | | | |
| **Procedures** | | | | |
| *Sub-activity RT1-Ma-1.1: Characterization of R4D Platform sites (Bougouni and Koutiala/Yanfolila districts):* A quick biophysical and social characterization of the R4DP site and an inventory of all stakeholders working within the site will be undertaken. This will involve a one-day workshop with all identified stakeholders above to conduct a stakeholder analysis and collect information on existing forms of interaction amongst stakeholders as well as information on indicators that are likely to be influenced by the presence of R4DP.  *Sub-activity RT1-Ma-1.2: Quick assessment of relevant stakeholders:* The main objective of this is to document all organizations, external and internal, that are working within the R4D Platform site. This information can be obtained from secondary sources such as the site selection reports for Bougouni and Koutiala (early 2013), key informant interviews and/or through field visits. At least the following groups and institutions need to be covered: farmers, farmer groups, farmer organizations, local government authorities, NARES, input suppliers, agro-dealer shops, NGOs, local institution governing access and use of natural resources, policy and decision makers and other project implementing organizations.  *Sub-activity RT1-Ma-1.3: Stakeholder analysis and mapping:* All the partners identified will be invited to a one day stakeholders’ meeting to carry out stakeholder analysis, existing interactions of the stakeholders, the types and intensity of interactions, and to get stakeholders to analyse their innovation capacity. This will involve individuals from the represented organizations answering a set of questions in a questionnaire. These questions will be used to map the existing linkages and analyse the strength of the linkages using social network analysis and to make an assessment of different micro-scenarios that represent different elements of the interactions and innovation capacity such as knowledge sharing, and coordination of activities to triangulate the information. This short questionnaire can be administered during the stakeholder analysis workshop.  *Sub-activity RT1-Ma-1.4: Multi-stakeholder national workshop for feedback on results of the different work packages:* A two-day workshop will be organized (in Bamako in March 2014 and Bougouni or Koutiala in November 2014) to present recent findings to partners and adjust plans accordingly to improve integration and synergies. The first day is reserved for presentations, while the second day will allow for adjusting plans, improving integration and identification of synergies. On the first day, the leader or deputy leader of each work package will present the general results; while one to three presentations per work package will allow for detailed information on results and lessons learnt. This will lead to four, short, work package presentations and between four to eight in-depth presentations with discussions. On the second day, opportunities and constraints arising from the presentations will be identified and work groups will be formed to articulate how these can be dealt with and how we can ensure synergies between activities within a given work package and between work packages.  *Sub-activity RT1-Ma-1.5: Establish and assess impact of R4D Platforms on technology adoption:* Methodological and capacity building workshops on R4D Platforms and kick-off meetings will be organized. The implementation process will be reviewed and lessons learnt documented. Participatory approaches will be used to monitor and evaluate the activities of the R4D Platforms. Household surveys and focus group discussions will be conducted with the various R4D Platforms to assess the socio-economic impact of the R4D Platforms on technology adoption and market participation. | | | | |
|  | | | | | |
| **Activity RT1-Ma-2** | | Monitor market prices and characterize value chains | | |
| Lead Scientists(s) | | Mulubirhan Amare and Ousmane Sanogo | | Institution: ICRISAT, IER |
| Other scientist(s) | | Katrien Descheemaeker | | |
| Student(s) | | Mary Ollenburger | | |
| Location(s) | | Koutiala and Bougouni/Yanfolila districts | | |
|  | | | | |
| **Procedures** | | | | |
| *Sub-activity RT1-Ma-2.1: Monthly monitoring of prices of agricultural products in three large, weekly markets in Koutiala and Bougouni:* An existing data collection protocol (developed in the McKnight project) for surveying agricultural inputs and outputs is shared with partners for comments and validation. With input from local partners, three major markets will be identified for the study in the Koutiala and Bougouni areas. The validated protocol is then used to survey and monitor market prices on a monthly basis for a period of two years. Data will be entered and presented in tabular form every 6 months and a synthesis of results and main conclusions are presented in a short report every year from the start of monitoring. This information is used whenever necessary (in the IP meetings, in the country meetings, during feedback sessions and cost-benefit analyses with farmers and for farm system analyses).  *Sub-activity RT1-Ma-2.2: Annual monitoring of basic farming household characteristics in Africa RISING villages:* Annual monitoring and updating of basic household assets (animals, land allocated to different crops, equipment, household members and prices of agricultural commodities). The existing data collection protocol (developed in 2013) is amended, validated and used to collect data on an annual basis (March-April). Data is entered and shared with partners for their use (mainly for farm system analyses, may also be useful in discussions in innovation platforms/feedback, review and planning workshops at different levels).  *Sub-activity RT1-Ma-2.3: Value chain studies on at least three value chains identified by the R4D platforms:* The R4D Platforms at the district level will identify promising value chains on which analyses will be performed. Analyses will be conducted by MSc. students (still to be identified), results shared and validated in district level and national level meetings. | | | | |

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| **Activity RT1-Ma-3** | Economic validation and monitoring adoption of sustainable intensification options | |
| Lead Scientists(s) | Bekele Kuto | Institution: IITA |
| Other scientist(s) | Mulubirhanu Amare, Ousman Sanogo |  |
| Location(s) | Koutiala and Bougouni/Yanfolila districts | |
|  | | |
| **Procedures** | | |
| *Sub-activity RT1-Mal-3.1: Economic validation of improved agricultural technologies.* A number of technologies are being identified in biological trials in Mali. However, socio-economic information about the technologies is lacking. The study aims to evaluate selected technologies from the socio-economic point of view. It will involve: 1) providing socio-economic input to publication of completed studies; 2) collection and analysis of data on on-going trials; and 3) in-depth socio-economic assessment of selected technologies.  *Sub-activity RT1-Ma-3.2: Analysis of the applications of SI practices in West Africa:* Agricultural intensification requires more inputs (such as labor and commercial inputs) per unit of land in order to produce more outputs per unit of land, while its sustainability entails the use of multiple technologies in an integrated manner. Despite this fact, previous studies focused on adoptions of agricultural technologies separately (e.g. improved seeds, fertilizer). This piecemeal approach can only provide a partial answer to sustainable intensification of smallholder agriculture. Therefore, this study aims to examine the adoption of sustainable agricultural practices and technologies in an integrated manner using availale AR baseline data for Mali. | | |

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| **4. RT1-Ma activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Establish and facilitate R4D platforms | x | x | x | x | x | x | x | x |  |  |  |  |
| 2. Monitor market prices/value chains | x | x | x | x | x | x | x | x |  |  |  |  |
| 3. Economic validation of SI options |  |  |  | x | x | x | x | x | x | x | x | x |

|  |  |  |  |  |
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| **5. Expected results/deliverables** | | 2014 | 2015 | 2016 |
| 1 | Establish at least two community level R4D Platforms | x | x |  |
| 2 | Report on market prices of agricultural inputs and outputs | x | x |  |
| 3 | Reports on value chain in Koutiala and Bougouni/Yanfolila districts | x | x |  |
| 4 | Report on socio-economic analysis of 4-6 technologies |  | x | x |

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| **6. Expected outcomes** | | Short | Medium | Long |
| 1 | Increased interaction among stakeholders through the R4D platforms | x | x |  |
| 2 | Research institutions use R4D platforms and less of the linear approach |  | x | x |

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| **7. 2015 Budget (US$)** | | | | | | |
| Theme/Activity | Budget Line | ICRAF | AMEDD | MOBIOM | ICRISAT | IER |
|  |  |  |  |  |  |  |
| RT1-Ma-1 | Personnel | 11400 | 2000 | 1500 | 2000 |  |
|  | Services | 2000 | 1500 | 500 | 4000 |  |
|  | Supplies | 15600 | 500 | 0 | 6000 |  |
|  | Travel | 25500 | 1000 | 1000 | 8000 |  |
|  |  |  |  |  |  |  |
| RT1-Ma-2 | Personnel |  |  |  | 25,000 | 3000 |
|  | Services |  |  |  | 5,000 | 5000 |
|  | Supplies |  |  |  | 5,000 | 1000 |
|  | Travel |  |  |  | 5,000 | 3000 |
|  |  |  |  |  |  |  |
| MT1-3 | Personnel |  |  |  | 0 |  |
|  | Services |  |  |  | 0 |  |
|  | Supplies |  |  |  | 0 |  |
|  | Travel |  |  |  | 0 |  |
|  |  |  |  |  |  |  |
|  | **Total** | **54500** | **5000** | **3000** | **60,000** | **12,000** |
|  | Grand total |  |  | **134500** |  |  |

**Theme 2: Intensifying cereal-legume-vegetable cropping (RT2-Ma)**

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| --- | --- | --- | --- | --- |
| **1. Research team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Ramadjita Tabo | ICRISAT | PhD | Agronomy | Leader Activity RT2-Ma-1 |
| Birhanu Zemadim | ICRISAT | PhD | Land and water | Coordination |
| Albert Rouamba | AVRDC | PhD | Vegetable breeding | Deputy PI |
| Keriba Coulibaly | AVRDC | MSc | Agricultural economics | Managing trials |
| Gatien Falconnier | ICRISAT | MSc | Farming systems | Managing trial |
| Catherine Dembele | ICRAF | PhD | Agroforestry | Managing trials, data analyses |
| Fatoumata Traoré | ICRAF | BSc | Leafy vegetable | Monitoring trials |
| Mary Ollenburger | WUR | MSc | Farming systems | Managing trials, |
| Eva Weltzien | ICRISAT | PhD | Sorghum breeding, | Seed production, monitoring trials |
| Ousmane Sanogo | IER | PhD | Farming systems | Market study |
| Katrien Descheemaeker | WUR | PhD | Farming systems | Farming systems |
| Jeroen Groot | WUR | PhD | Faming systems | Farming systems analysis |
| Joachim Binam | ICRAF | PhD | Socio-economy | Economic evaluation |
| Odjouma Samaké | ICRAF | MSc | Agroforestry | Managing trial |
| Bréhima Koné | ICRAF | MSc | Agroforestry | Managing trial |
| Haile Desmae | ICRISAT | PhD | Breeder | Managing trial |
| Dekoro Dembele | ICRISAT | MSc | Breeder asst | Managing trial |
| Caroline Sobgui | AVRDC | PhD | Nutritionist | Leading nutrition activities |
| Moussa Kanoté | AVRDC | MSc | Nutrition asst | Assisting nutrition studies |

**2. Objectives**

1. Evaluate the impact of participatory varietal testing in combination with improved crop management options on the demand for and sales of agricultural inputs and seeds of improved varieties of a range of crops (vegetables, field crops and tree seeds/seedlings/grafts).
2. Facilitate access to knowledge and information about markets, options, integrated innovations and inputs for sustainable intensification in order to encourage adoption.
3. Strengthen the capacities of local stakeholders (farmers, extension and research staff…) in evaluating and testing sustainable innovation options associated with farm system components.

|  |  |
| --- | --- |
| 1. Test and evaluate the productivity and profitability of combinations of intensification options (improved varieties, hybrids, fertilizer application, (bio)pesticides, intercropping etc.) at the field scale | |
| 1. Test and evaluate the productivity and profitability of intensified livestock feeding options (stable feeding of small ruminants and dairy cows). | |
| 1. Feedback and discuss results of experimentation with participating farmers in participatory sessions in the villages and to a wider audience through the different platforms | |
|  | |
| 1. Identify and disseminate suitable cultivars or genotypes and efficient cultivation practices for intensive fruit production of *Ziziphus mauritiana*, *Tamarindus indica*, *Adansonia digitata* and *Vitellaria paradoxa.* | |
| 1. Identify efficient cultivation practices for intensive leafy vegetable production from *Moringa oleifera* and *Adansonia digitata*. | |
| 1. Identify tree species efficient for improving soil fertility, water conservation and fodder production | |
|  |  |
|  | Assess productivity and profitability of existing mixed cereal/legume-vegetable configurations |
|  |  |
|  | Collect quality data for parameterization of the farm systems components and the whole farm system |
|  | Parameterize models and determine efficiency with different combinations of intensification options |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **3. Activities and workplans** | | | | | | | |
| **Activity RT2-Ma-1** | | Intensifying productivity of cereal-legume cropping systems | | | | | |
| Lead Scientist(s) | | Ramajita Tabo | | | Institution: ICRISAT | | |
| Other scientist(s) | | Haile Desmae, Dekoro Dembele, Eva Weltzien, Birhanu Zemadim | | | | | |
| Graduate student(s) | | Mary Ollenburger, | | | | | |
| Location(s) | | Koutiala and Bougouni/Yanfolila | | | | | |
|  | | | | | | | |
| **Procedures** | | | | | | | |
| *Sub-activity RT2-Ma-1.1: Analyze and report data from cereal-legume-vegetable experiments conducted in 2012 and 2013:* ICRISAT and partners will collect protocols of trials and data collection and reporting in the protocols will be verified at the site and corrected where necessary and possible. Data will be entered and datasets evaluated for quality and quantity before proceeding with statistical analyses. Data will be cleaned and analyzed. Summarized results will be presented in project reports, shared with AR team and presented to farmers and local stakeholders in March in the AR villages. Where possible, a team of AVRDC and ICRISAT will have common trips and meetings presenting and evaluating rainy season cereal, legume and vegetable trials together.  *Sub-activity RT2-Ma-1.2: Organize feedback sessions with stakeholders:* Feedback sessions will be organized in each village to present and discuss the results with local partners and farmers. The feedback sessions will consist of four elements, namely (1) presentation and discussion of agronomic results, (2) identification of labor requirements for different treatments and cost-benefit analysis of one or more type of trials, (3) preference ranking of trial types, treatments (options) and (4) short brainstorming for ideas for next years’ trials. Data will be synthesized in a short report for Koutiala and Bougouni separately. If possible, these types of analyses will be performed for both the field crop and the vegetable crop trials to create a database of labor requirements for different crops. Farmer preferred varieties of cereals, grain legumes and vegetables will be identified and plans made to make seeds available for sale through the partners in the R4D platforms.  *Sub-activity RT2-Ma-1.3: Plan and perform trials on integrated intensification options for cereals and legumes:* Planning workshops will be held with participating farmers in each village to build on the results from the feedback sessions and develop a plan for next years’ activities. A maximum of five types of trials per crop type per district will be planned with a minimum of four farmers (replicates) per village. Type of trials and treatments for each type of trial will depend on previous results and farmers’ input. We aim to Implement 6 types of intensification trials in Koutiala where the cereals (sorghum, maize) and legumes (groundnut and cowpea) will be intercropped with vegetables - roselle. In Bougouni, trials will be more diverse, as we will be working with cooperatives focusing on organic farming and cooperatives focusing on conventional farming. Preferably, trials are simple 2x2 factor experiments considering farmers as repetitions. For each trial type, we will implement at least 4 repetitions in at least 3 villages (minimum of 12 trials per type) per district.  *Sub-activity RT2-Ma-1.4: Conducting on-farm participatory variety selection trials and groundnut varieties demonstrations in Koutiala and Bougouni*. The program involves implementation of activities in collaboration with two local NGOs: CAAD & GRAADECOM. The work involves provision of groundnut seeds and on-farm trials protocols to the local NGOs. Training is another component of the work and is provided to local farmers and technical staffs of partner institutes on the implementation and management of the on-farm trials. Field trip will also be organized to assess the progress of trials and field days will also be organized by the partners and ICRISAT. Similarly farm participatory evaluation in field will be conducted to enable farmers select preferred varieties; training on post-harvest management and Aflatoxin management will be provided and finally qualitative and quantitative data will be collected and analyzed. | | | | | | | |
|  | | | | | | | |
| **Activity RT2-Ma-2** | Improving productivity and profitability of cereal/legume-vegetable systems | | | | | | |
| Lead Scientists(s) | Albert Rouamba | | | Institution: AVRDC | | | |
| Other scientist(s) | Keriba Coulibaly, Ousmane Sanogo, Caroline Sobgui, Moussa Kanoté | | | | | | |
| Location(s) | Koutiala and Bougouni/Yanfolila (Dieba, Flola, Madina, Yorobougoula, Sibiril) | | | | | | |
|  | | | | | | | |
| **Procedures** | | | | | | | |
| *Sub-activity RT2-Ma-2.1: Assess productivity and profitability of integrated innovations for cereal/legume-vegetable cropping systems and identify opportunities for scaling:* Ten farmers (households) per village in each of five villages in each of the Bougouni and Koutiala districts (total of 100) will be selected to participate in testing and diffusion of promising new varieties of the most popular vegetable crops (okra, pepper, tomato and sorrel) in association with the dominant cereal (maize) or legume (groundnut) crops. Two series of trials will be carried out. The first series will test associations of maize with either okra, pepper or tomato in configurations of 100% maize (M), 100% vegetable (V), 75% M + 25% V, 50% M + 50% V, 25% M + 75% V, on plot area basis. In the second series, similar configurations will be used to evaluate the performance of roselle-groundnut associations. Data will be collected on yield and market value of the tested vegetable and maize/legume crops. It is intended that this work will form part of the thesis research of two MSc students to be identified from local universities or agricultural training schools in Mali (or neighboring countries) in consultation with partners.  *Sub-activity RT2-Ma-2.2: Test and disseminate promising technologies to intensify vegetable monocropping in cereal-based crop systems in off-season:* As this activity requires off-season infrastructure (fencing and well), only those villages with infrastructure will be concerned (Yorobougoula and Sibirila in Bougouni district and Sirakele, Zansoni and Mpessoba in Koutiala district). Participatory testing and diffusion of promising new vegetable cultivars will be carried out to deliver high value, multiple disease-resistant and nutrient-dense vegetable cultivars in the off-season.  Ten farmers (households) per village in each of five action villages in each of the Bougouni and Koutiala districts (total of 50) will be selected to participate in testing and diffusion of the four most popular vegetable crops (okra, pepper, tomato and sorrel). In each of the five target actions villages, the vegetable crops chosen will be compared across subsets of 10 households per village (depending on crop preference and seed avaibility) using two planting densities (farmer practice vs. recommended practice).  Data will be collected on yield, market value and utilization (contribution to dietary diversity) of the tested vegetables. It is intended that this work will form part of the thesis research of an MSc student to be identified. | | | | | | | |
|  | |  | | | | | |
| **Activity RT2-Ma-3** | | Agroforestry options for intensive fruit, vegetable and fodder production | | | | | |
| Lead Scientists(s) | | Catherine Dembele | | | Institution: ICRAF | |  |
| Other scientist(s) | | Joachim Binam, Odjouma Samake, Brehima Kone | | | | | |
| Student | | Traoré Fatoumata | | | | | |
| Location(s) | | Koutiala and Bougouni/Yanfolila districts | | | | | |
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| **Procedure** | | | | | | | |
| *Sub-activity RT2-Ma-3.1: Monitor fruit tree establishment trials established in 2013 for intensive fruit production:* In August 2013, a trial was established on intensive production of fruits from 7 cultivars of *Ziziphus mauritiana* (Ben Gourrion, Gola, ICRAF6, ICRAF8, ICRAF9, Kaithly, and Umran), 3 superior genotypes of *Tamarindus indica* (Niger 309, Thai sucré, Thai gros fruit), 1 genotype of *Adansonia digitata* (Nonokene) and 1 genotype of *Vitellaria paradoxa* (Samanko-ka). The objective was to determine the effect of manure fertilization and farmer’s choice of irrigation management on the growth and fruit production of 12 cultivars and genotypes from 4 fruit tree species indigenous to the Sahel. Two replicates of 3 grafted plants for each cultivar or genotype were planted in 5 villages retained for the intervention. These are Mpessoba, Sirakele and Zanzoni in Koutiala district and Sibrila and Yorobougoula in Bougouni district. Plant growth and fruit production will be monitored from 2013 to 2016. Data will be cleaned and analyzed for reporting and publication.  *Sub-activity RT2-Ma-3.2: Intensive leafy vegetable production from Adansonia digitata (*baobab*)* and *Moringa oleifera:*  Baobab and *Moringa* are two tree species producing high value vegetable for human nutrition. The leaves, rich in calcium and good quality protein, are used green or dried as vegetables everywhere in the Sahel zone in Africa. However, leaves are collected mainly during the rainy season. In order to get fresh leaves year round, intensive method of cultivation is suggested using fertilization and irrigation in each of the 5 target villages. The effect of manure and phosphorus fertilization will be determined. Leaf production will be monitored from 2014 to 2016. Data collected will be analyzed for reporting and publishing. This activity will be linked to nutrition (WP-10: sub-activities 5.2 and 5.3) by raising awareness of the nutritional benefits of *Moringa* and Baobab and testing ways of using the leaves in a variety of recipes.  *Sub-activity RT2-Ma-3.3: Improving soil fertility using fodder and fertilizer tree species*  Four fertilizer and fodder tree species trials (*Acacia angustifolia, Gliricidia sepium Calliandra calothyrsus* and *Sesbania sesban*) will be planted in at least 5 fields in each of the 5 target villages (Mpessoba, Sirakele and Zanzoni in Koutiala area and Sibirila and Yorobougoula in Bougouni/Yanfolila area). In villages and fields where the contour bund technology (CBT) will be tested (WP-9: sub-activity 4.2), an effort will be made to implement these tests in field with and without CBT. The growth, fodder and wood production of the four species will be measured and the effect of the fodder tree species on soil fertility and soil water dynamics will be monitored. The possibilities of harvesting leaves for livestock feeding trials will be explored, thus linking to Activity 1.4 of this work package. Data collected will be analyzed for reporting.  *Sub-activity RT2-Ma-3.4: Establish improve fruit trees and food banks within technology park*  Within the 2 technology parks, Mpessoba and Flola, superior accessions of *Tamarindus indica*, *Adansonia digitata* and cultivars of *Ziziphus mauritiana* will be established along with vegetable crops in collaboration with AVRDC if possible. Baobab and moringa will be established in garden plots for leafy vegetable production.  *Sub-activity RT2-Ma-3.5: Train volunteers for nursery plant propagation by seeds and grafting for private plantation.* Volunteer farmers of the 10 villages will be trained and support for seedling propagation and grafting in nursery in order to allow them to continue tree planting behind the end of Africa RISING project | | | | | | | |
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| **Activity RT2-Ma-4** | | | Estimate efficiency of components and whole farm systems | | | | |
| Responsible Scientist(s) | | | Mulubrhan Amare | | | Institution: ICRISAT | |
| Other scientist(s) | | | Katrien Descheemaeker, Jeroen Groot | | |  | |
| Student | | | Mary Ollenburger | | |  | |
| Location(s) | | | Koutiala and Bougouni/Yanfolila districts | | | | |
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| **Procedures** | | | | | | | |
| *Sub-activity RT2-Ma-4.1: Define and propose a framework for data sharing between Africa RISING partners and Wageningen University:* Wageningen University shares a list of parameters necessary for different types of modeling efforts and analyses that they want to do at the farm and field scale. This list will be reviewed by the scientists involved with on-farm experimentation. Then, a matrix of available and to be collected data (bases) and type of modeling/analyses is created and a plan of action is made to collect complementary data where possible to allow for analyses at farm and field scale. A document is created and reviewed that states the agreed rules for sharing data and information within Africa RISING working groups, including issues related to authorship in case of publication of results.  *Sub-activity RT2-Ma-4.2: Parameterize component and whole farm system models and determine trade-offs:* Components of dynamic simulation models (FarmSIM), dynamic farm planning model (FarmSTEPS) will be parameterized. The effects of different combinations and scenarios of intensification options on farm efficiency, productivity and landscape ecosystem functioning in different scenarios of socio-economic and biophysical developments will be simulated (ex-ante analysis). Farm scale modeling of NRM and intensification options will be undertaken to analyze trade-offs and synergies between productivity (and profitability), the use of natural resources and provision of ecosystem services (water, soils, carbon and nutrients, biodiversity) within farming systems and between these systems and the surrounding farms and landscape. | | | | | | | |

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| **4. RT2-Ma activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Improving cereal-legume cropping systems | x | x | x | x | x | x | x | x | x | x | x | x |
| 2. Improving vegetable cropping systems |  | x | x | x | x | x | x | x | x | x | x | x |
| 3. Intensive fruit, vegetable and fodder sy |  | x | x | x | x | x | x | x | x | x | x | x |
| 4. Estimating farm efficiency |  | x | x | x | x | x | x | x | x | x | x | x |

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| **5. Deliverables** | | 2014 | 2015 | 2016 |
| 1 | Report on cereal-legume trials implemented | x | x | x |
| 2 | Database on agronomy of different SI options and combinations |  | x | x |
| 3 | Report on fruit, fodder and fertilizer trees and leafy vegetables | x | x | x |
| 4 | Report on integrated cereal/legume-vegetable systems | x | x | x |
| 5 | Matrix of data (bases) for modeling | x |  |  |
| 6 | Parameterized models for farm system components and farm types | x |  |  |
| 7 | Ex-ante analysis of the effect of various intensification options |  | x |  |
| 8 | Report on farm efficiency, profitability and trade-offs options | x | x | x |

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| **6. Expected outcomes** | | **2014** | **2015** | **2016** |
| 1 | Farmers are adopting improved technologies to improve traditional farming | x | x | x |
| 2 | Communities are managing their natural resources without conflict |  | x | x |
| 3 | Scientists are validating and adapting the models developed |  | x | x |

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| **7. 2015 Budget (US$)** | |  |  |  |  |  |  |  |
| Theme/Activity | Budget line | ICRISAT | AVRDC | ICRAF | IER | MOBIOM | CAAD | GRADCOM |
| RT2-Ma-1 | Personnel |  |  |  |  | 1500 | 3000 | 3000 |
|  | Services | 10000 |  |  |  | 500 | 2000 | 2000 |
|  | Supplies | 10000 |  |  |  | 500 | 1000 | 1000 |
|  | Travel | 10000 |  |  |  | 2000 | 1000 | 1000 |
|  |  |  |  |  |  |  |  |  |
| RT2-Ma-2 | Personnel |  | 40000 |  | 3100 | 1500 |  |  |
|  | Services |  | 30000 |  | 5500 | 500 |  |  |
|  | Supplies |  | 40000 |  | 2000 | 1000 |  |  |
|  | Travel |  | 15000 |  | 2700 | 2000 |  |  |
|  |  |  |  |  |  |  |  |  |
| RT2-Ma-3 | Personnel |  |  | 15000 |  | 1300 |  |  |
|  | Services |  |  | 10000 |  | 700 |  |  |
|  | Supplies |  |  | 10000 |  | 500 |  |  |
|  | Travel |  |  | 15000 |  | 500 |  |  |
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| RT2-Ma-4 | Personnel | 20000 |  |  |  |  |  |  |
|  | Services | 5000 |  |  |  |  |  |  |
|  | Supplies | 10000 |  |  |  |  |  |  |
|  | Travel | 5000 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  | Total | **70000** | **125000** | **50000** | **13300** | **12500** | **7000** | **7000** |
|  | Grand total |  |  | 284800 |  |  |  |  |

**Theme 4: Land, soil and water management (RT4-Ma)**

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| **1. Research Team** | | | | |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Birhanu Zemadim | ICRISAT | PhD | Watershed Management, | Leader, RT4-Ma-1,4, 5 |
| Augustine Ayantunde | ILRI | PhD | Livestock management | Leader, RT4-Ma-2, 3 |
| Ramadjita Tabo | ICRISAT | PhD | Agronomy | Monitoring Agronomic Work |
| Mary Ollenburger | WUR | MSc | Farm systems research | Graduate student |
| Kalifa Traore | IER | PhD | Water and soil | Watershed activities |
| Mahamadou Dicko | ICRISAT | MSc | Technology Parks | Coordination |
| Karamoko Traore | ICRISAT | MSc | Technology Parks | Coordination |
| Clarisse Umutoni | ILRI | MSc | Conflict management | Graduate student |
| Bougouna Sogoba, | AMEDD | MSc | Biomass assessments | Contact local partner |
| Katrien Descheemaeker | WUR | PhD | Modelling/Farming systems | Modeling intensification |
| Gilbert Dembélé | AMEDD | MSc | Biomass assessments | Technician |
| Bougouna Sogoba, | AMEDD | MSc | Biomass assessments | Contact local partner |
| Cedrick Guedessou | ICRISAT | MSc | Watershed management | Research assistant |
| Marc Traore | ICRISAT | BSc | Organizational | Negotiation |
| Gumma Krishna | ICRISAT | PhD | GIS and RS | Watershed Development |
| Djelika Two | ICRISAT | MSc | ????? | Coordination, technology park |

**2. Objectives**

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| 1 | Determine pasture biomass at the village level and map grazing routes by village herds. |
| 2 | Study strengths and weakness of local conventions and identify options to strengthen them. |
| 3 | Analyze causes of conflicts over natural resource use and options for participatory conflict management. |
| 4 | Assess the effects of transhumant practices on natural resource management (NRM). |
| 5 | Identify and characterize watersheds and their communities for sustainable agricultural intensification. |
| 6 | Identify appropriate NRM options and use models to study their impact at different scales. |
| 7 | Model intensification and land use at the village-level using participatory approaches. |

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| **3. Activities and work-plans** | | |
| **Activity RT4-Ma-1** | Determine pasture biomass at village-level and map grazing itineraries | |
| Lead Scientists(s) | Birhanu Zemadim | Institution: ICRISAT |
| Other scientist(s) | Gumma Murali Khrishan, Gilbert Dembélé, Bougouna Sogoba | |
| Graduate student(s) | Mary Ollenburger | |
| Location(s) | Koutiala, Bougouni and Yanfolila districts | |
|  | | |
| *Sub-activity RT4-Ma-1.1: Village-level biomass and pasture assessment and mapping of grazing itineraries:* Biomass assessments have begun in Sibirila and Dieba villages in Bougouni (and will be conducted by other projects in Koutiala). This activity will continue until September 2015 and will be complemented with animal census information and grazing itineraries. Annual peak biomass assessment in pasture was complemented by crop and weed information from the detailed farm characterization survey and sampling conducted by Wageningen UR in 2013; crop field sampling will be repeated in 2014 on the same 19 farms in two villages to characterize feed resources available throughout the year.  Pasture sampling follows a hierarchical sampling strategy: non-cropped areas have been stratified by land use types. A total of 12 sampling boxes per village were identified by selecting points at random from within each land use type. Within each box, a systematic sample of five 1m x 1m quadrats is sampled for total biomass, species composition, and subsamples are taken for dry matter determination and quality analysis. Sampling is repeated every two months in adjacent quadrats to estimate seasonal biomass and forage availability.  *Sub-activity RT4-Ma-1.2: Mapping of grazing itineraries:* In order to complement the assessment of available feed resources at village level, utilization patterns must be established. To this end information on herd composition and grazing itineraries will be collected for 10 village herds in the villages of Sibirila and Dieba. Animal numbers, types, ages, and gestational status will be recorded and movements will be tracked using GPS collars throughout one year to estimate pasture utilization and pressure on grazing resources in different parts of the village territory. This information will help people make informed decisions about use of pasture resources. Thus information from this activity can contribute to reinforcing local conventions. | | |

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| **Activity RT4-Ma-2** | Document and validation of existing local conventions | |
| Lead scientists(s) | Augustine Ayantunde | Institution: ILRI |
| Graduate student(s) | Clarisse Umutoni |  |
| Location(s) | Koutiala, Bougouni and Yanfolila districts | |
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| **Procedures** | | |
| *Sub-activity RT4-Ma-2.1: Documentation of existing local conventions:* This activity will build on the on-going surveys on the local conventions in the project sites. Group discussions among the local administrative authorities, technical services and customary leaders will be conducted as well as individual interviews to document the processes involved in the elaboration, implementation, monitoring and evaluation of the existing local conventions. Between 25 and 30 individuals in each community will be interviewed to document the perception and knowledge of local populations of local conventions governing natural resource management in the community. In addition, this study will also assess the knowledge, attitude and skill of the community members in relation to natural resource management interventions including local conventions. Results of this activity will provide useful information for activities on conflict management and transhumant practices (in the study sites.  *Sub-activity RT4-Ma-2.2: Validation workshops on local conventions:* Building on the ongoing study on the analysis of the strength and weakness of the local conventions started in 2013 in the intervention communities, we are going to organize a validation workshop to share the results of the study in the project sites and develop plan for strengthening the elaboration and implementation processes of the existing local conventions in the project communities. Technical and judicial experts will be brought in to build the capacity of the key stakeholders at local government level as well as traditional leaders regarding the elaboration, implementation, monitoring and evaluation of the local conventions. Ten opinion leaders including two women who are well informed about the existing local conventions will be invited from each intervention community for the workshop which will take place in Bougouni and Koutiala. In addition, officials from the administrative and technical services will be invited for the workshop. After validation of the results, there will be group discussion per community on plans to strengthen the existing local conventions including the technical, institutional and social interventions including land use plans. Later, another workshop will be organized to assess the implementation of the proposed plans in each community. Each workshop will last for 1 day. Results of these workshops will feed into Activity 3, WP-M1 on multi-stakeholder national workshop for feedback on results from the project activities.  *Sub-activity RT4-Ma-2.3.* *Development and formalization of existing local conventions*: Results of the preliminary analysis of the existing local conventions in 6 Africa RISING intervention communities in Bougouni and Koutiala showed that the local conventions are oral and informal, which essentially renders them largely ineffective. To address this major weakness, we plan to develop and formalize the existing oral conventions in 3 Africa RISING communities namely, Dieba in Bougouni district, Sirakele and Zanzoni in Koutiala district. The development and formalization of the local conventions will provide opportunity for necessary administrative recognition and support at the local government authority (“Commune rurale”). Besides, this will facilitate the use of local conventions for land use planning in the communities. Specific tasks that will be involved in the development and formalization of local conventions are: (i) Case study of the formalized local conventions and land use plans in Yorosso commune in Southern Mali. The objective of this case study is to learn and capitalize on the experiences at this commune in development and formalization of local conventions for the Africa RISING intervention communities. (ii) Meeting of key stakeholders at community level to discuss the processes and modalities for the development and formalization of existing local conventions. (iii) General meeting at the community level to inform and sensitize on the development processes of the existing oral conventions. (iv) Participatory mapping by the community of natural resources and key features in the territory. (v) Documentation of the existing local conventions in writing and review by the community leaders. (vi) Community workshop for the signing of the documented local conventions by key leaders; (vii) Engagement of the local administrative authority and technical services for the review of the texts of the local conventions developed by the community and formalization. (viii) Setting up of village committee to monitor the enforcement of the formalized local conventions.  *Sub-activity RT4-Ma-2.4.* *Land use change analysis:* To support the development and formalization processes of existing local conventions in the 3 intervention communities, map of land use change analysis will be developed for each community. The land use analysis will compare the changes in land use patterns between 1984 and 2009 using Landsat data. This analysis will provide insight and relevant information on changes in land use patterns in each community which can help to identify rules to be included in the local conventions for access and use of different land use types and ensure sustainable use of the natural resources in the community. | | |

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| **Activity RT4-Ma-3** | | | Explore options for participatory conflict management | | | | | | | | | | | | | | | |
| Lead scientists(s) | | | Augustine Ayantunde | | | | | | | Institution: ILRI | | | | | | | | |
| Graduate student(s) | | | Clarisse Umutoni | | | | | | |  | | | | | | | | |
| Location(s) | | | Koutiala, Bougouni and Yanfolila districts | | | | | | | | | | | | | | | |
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| **Procedures** | | | | | | | | | | | | | | | | | | |
| *Sub-activity RT4-Ma-3.1: Workshops on conflict management:* Conflict over natural resource use is common in Sudano-Sahelian zone and could be attributed to many factors. Conflict is best managed at the local level but this depends on the leadership skills and capacity of the local institutions. Where there is strong local institutions, most cases of conflict are normally resolved. Given the importance of local institutions in managing and resolving conflict over natural resource use, it is necessary to build their capacity. To build the capacity of local institutions in conflict management, a training workshop will be organized in Bougouni and Koutiala. Ten participants from the local communities will be invited including the key stakeholders from the local institutions including formal administrative authorities, customary leaders and leaders of key social groups. The training will address methods/tools for participatory conflict analysis, conflict timeline, mapping conflict over natural resource use, social relations and communication, and 4Rs analysis (Right, Responsibility, Response, and Relationship) of conflict management. A consultant from Mali will lead the training which will be conducted in Bougouni and Koutiala. The workshop will last for 2 days. Results of these workshops will feed into multi-stakeholder national workshop for feedback on results from the project activities.  *Sub-activity RT4-Ma-3.2: Participatory conflict analysis and management:* Farmer-herder conflicts are enduring features of social life in the Sudano-Sahelian zone. This activity will focus on participatory analysis of conflict management in the intervention communities with the aim of determining the proximate and long-term causes of conflict over natural resource use, evaluating the appropriateness of existing institutional arrangements for managing conflicts and identifying innovative options and incentives to reduce the incidence and severity of conflicts. The research will employ both quantitative and qualitative survey instruments to collect information on historical micro-geographies of cropping and herding in the area encompassing village territory; local day-to-day relationships between transhumance herders, settled herders, and farming households at the study site; nodes of communication under different types of disagreements and negotiate settings; documentation of past conflicts and role of government officials, customary authorities and NGOs in conflict management. The group discussions will involve key stakeholders in conflict management in the communities as well as administrative authorities. In addition, between 25 and 30 individuals will be interviewed. This activity links well with activity on documentation of existing local conventions and will inform identification of strategies to strengthen the local conventions.  *Sub-activity RT4-Ma-3.3: Documentation of transhumance practices:* This activity on transhumant practices and the impact on natural resource management will document the current practices, and the local perceptions on benefits and constraints of transhumance. Group discussions as well as individual surveys will be conducted in the intervention communities. Attempt will be made to map the transhumant routes or livestock corridors in the land use maps of the communities. The goal of the mapping is to ensure clear demarcation of the animal corridors to ensure unhindered livestock mobility and encroachment through crop farming. Stakeholders’ meeting will be organized on measures to respect the animal corridors. This activity links well with activity on documentation of existing local conventions and will inform identification of strategies to strengthen the local conventions. Also, results from this activity will enhance better understanding of the maps of the grazing itineraries.  *Sub-activity RT4-Ma-3.4.* *Demarcation of livestock routes to reduce farmer-herder conflict:* One of the major causes of farmer-herder conflict is expansion of crop field into livestock routes based on the survey we have conducted in 6 Africa RISING intervention communities in Bougouni and Koutiala districts. The development and formalization of the existing local conventions will help to prevent the expansion of crop field into the livestock routes but this has to be supported by practical measures such as demarcation of the livestock routes. We therefore plan to demarcate 10 km of livestock routes in the territory of Dieba, Sirakele and Zanzoni. Together with key natural resource management actors in each community, the livestock routes to be demarcated will be identified and marked. Appropriate government technical services will be involved to ensure that identified livestock routes to be demarcated agree with national transhumance routes, where these exist. Besides, their involvement will also provide the necessary approval for the demarcation of the livestock routes. To assess the impact of the demarcation of livestock routes on the incidence of conflict in each community, cases of farmer-herder conflict will be documented every six months and will be compared with the baseline data in 2014. | | | | | | | | | | | | | | | | | | |
| **Activity RT4-Ma-4** | Establish and characterize watersheds for integrated research | | | | | | | | | | | | | | | | | |
| Lead Scientists(s) | Birhanu Zemadim | | | | | Institution: ILRI | | | | | | | | | | | | |
| Other scientist(s) | Gumma Murali Khrishan, Cedrick Guedessou, Marc Traore | | | | | | | | | | | | | | | | | |
| Graduate student(s) | Mary Ollenburger, Djelika Toure | | | | | | | | | | | | | | | | | |
| Location(s) | Koutiala | | | | | | | | | | | | | | | | | |
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| *Sub-activity RT4-Ma-4.1: Establish and characterize two technology parks for integrated research: Two* technology parks (one in Bougouni and the other in Koutiala) will be identified within the Africa RISING action village areas to integrate multiple activities, and to identify major researchable issues that require integration of different research components. It is expected that activities will be worked to produce a common output. In establishing the technology park area several social and biophysical characteristics will be taken into account. For example the willingness of communities to be part of the research program is a priority concern. Thus approval from the local government authorities and local village elders is important. Physiographic characteristics namely presence of elevation, different agronomic practices (rainfed, small scale irrigation systems, land, labor, market will be considered).  In the identified watershed existing data on local farm practices, water uses, traditional land and water management activities and opportunities for improvement are studied. Similarly physiographic characteristics including drainage density, slopes are evaluated. Agro-hydrological characteristics including climatic conditions, land use and land cover pattern and soil nutrients are evaluated. Existing eco-system functions involving benefits that build up from the use an integrated management of natural resources capital are evaluated in the watershed program. Local land and water management interventions at both farm and community (watershed level) are mapped using GPS to characterize the spatial extent of natural resources management in the watershed. This activity generates evidence on the current NRM to support the information needed in sub-activities 3.3 and 4.2. The traditional practices in NRM will be closely aligned with the identification, validation and strengthening of local conventions.  *Sub-activity RT4-Ma-4.2: Farmers training on contour bund technology (CBTs):* At least two CBT trainings will be organized (one in Koutiala and one in Bougouni). Contour Bunding Technology (CBT) has been widely applied in few regions of Mali since 1995 as an effective land and water management intervention. There are existing potentials to further intensify its application which requires training farmers on its use and practices to improve household incomes and conserve the resource capital. At least two CBT trainings will be organized (one in Koutiala and one in Bougouni) in Sikasso region of southern Mali in close collaboration with IER and AMEDD. The current activity will be aligned with the social and biophysical characteristics of the R4D platforms developed in Koutiala and Bougouni.  *Sub-activity RT4-Ma-4.3: Experimentation on appropriate land and water management technologies:* Contour Bunding Technology (CBT) has been widely promoted as a sustainable land and water management technology in Mali. Benefits including runoff control and prevention of soil erosion and extension of crops growing period were the main targets of the CBT applications. However since its application there are limited research activities to understand its impact on water runoff, erosion, crop productivity and ecosystem services. Therefore it is planned to experiment the CBT technology in few Africa RISING villages and integrate other programs for example the farm/field level intensification options of the Africa RISING program. The experimentation will be done in the identified watershed where part of the watershed area will be treated for CBT and part of the area is reserved for control. In the treatment and control portions various crop intensification options for example levels of fertilizer/manure applications, crop varieties, treatments and management options will be studied to understand the changes in crop yield, biomass and fodder productivity and the gains in eco-system services. Similarly monitoring stations (runoff, soil moisture, sediment, ground water level) will be established in both control and treatment and the changes in biophysical and eco-system conditions will be monitored in close collaboration with local communities. Here communities will be trained in participatory monitoring skills. Hence output of the CBT practices will be experimented through biophysical monitoring and crop productivity. Monitored data in terms of changes in water level in identified boreholes and streams outlet locations, soil moisture status, erosion and sedimentation rates provide biophysical impacts of CBT interventions in the watershed. Similarly crop yield, biomass, regeneration of vegetation will be monitored both at control and treated watershed to quantify the impact of intervention. Spatial data will be mapped using GIS and data analysis help to characterize the in situ water use efficiencies, land degradations and intensification options for crop productivity status from farm to small watershed scale. Similarly the various crop intensification options under technologies of land and water management will support the development of scenarios for modeling. The activity will look in to efficiency of farm systems under various intensification options.  *Sub-activity RT4-Ma-4.4: Modeling from field to watershed level using biophysical model:* Various farm to small scale watershed intervention outputs will be combined to develop appropriate natural resources management practices. Information obtained from the baseline reports, field investigations and experimental analysis will be modeled using the Soil and Water Assessment Tool (SWAT) model. The model simulates the Blue and Green Water and help to simulate the gains in biophysical settings due to intervention options on land and water management practices. The model also simulates crop productivity under various land and water management options. Monitored data from the watershed will be used to calibrate and validate the model. The validated model will be used to develop various scenarios that help to intensify the farm/watershed scale intervention of land and water management. Hence impacts of land and water management practices will be established at a scale which is appropriate to intensify agricultural productivity in the study region. | | | | | | | | | | | | | | | | | | |
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| **Activity RT4-Ma-5** | | Model intensification and land use at village level | | | | | | | | | | | | | | | | |
| Lead Scientists(s) | | Birhanu Zemadim | | | | | | | Institution: ICRISAT | | | | | | | | | |
| Other scientist(s) | | Katrien Descheemaeker | | | | | | |  | | | | | | | | | |
| Graduate student(s) | | Mary Ollenburger | | | | | | |  | | | | | | | | | |
| Location(s) | | Bougouni district –Sibirila and Dieba villages | | | | | | | | | | | | | | | | |
|  | |  | | | | | | | | | | | | | | | | |
| **Procedures** | | | | | | | | | | | | | | | | | | |
| In Sikasso region there are strong interactions both among farms and between farms and the surrounding non-cropped areas. Therefore it is important to integrate farm-scale intensification and larger-scale land use and natural resource management, to assess potential impacts of technologies and institutions. Agent-based models can integrate biophysical and social system components and serve as tools for informing discussion of scenarios for system change. Summary models of farm system components and processes in non-cropped areas will be based on results from field trials, farm characterization (WUR situation analysis), and biomass assessment grazing itineraries. Decision algorithms will be built in collaboration with farmers through focus group discussions and descriptive games. Scenarios for possible futures will be developed in workshops with key stakeholders and technology options as well as institutional innovations will be explored under these scenarios. This will allow us to explore possible effects of integrating farm-scale technologies with scenarios involving strengthened local conventions and improved management of natural resources at larger scales. Models will be used to explore ways to minimize trade-offs between improving farm production and farmer livelihoods and conserving natural resources, in discussion with farmers and local stakeholders.   |  |  |  |  | | --- | --- | --- | --- | | **Activity RT4-Ma-6** | Mapping landuse/ Landcover (LULC) and temporal changes in LULC – dynamics | | | | Lead Scientists(s) | Gumma Murali Krishna | Institution: ICRISAT | | | Other Scientist(s) | Birhanu Zemadin | | | | Location(s) | Sikasso region of Mali | | | |  | | | | | **Procedures** | | | | | *Sub-activity RT-Ma-6.1: LULC mapping and quantify changes temporally:* Landuse and Landcover mapping using LANDSAT 8, 16 day repeat imagery along with MODIS @ 250mts 8 day composites. With extensive ground information and advanced classification techniques, accurate LULC maps can be generated for the Sikasso region. | | | | |  | | | | | *Sub-activity RT-Ma-6.2: Impact of adoption of NRM technologies:* Adoption of NRM technologies suitable for the location triggers changes in the biophysical environment which may be positive or negative. The impact of these technologies will at the same time, facilitate the targeted objectives. Remote sensing and GIS tools can be used to quantify the impact of adoption of these technologies. | | | | |  | | | | | *Sub-activity RT-Ma-6.3: Biomass estimation using NDVI:* Biomass will be estimated using multi-spectral data from LANDSAT 8 and MODIS imagery. Biomass sampling will be carried out on the selected fields during the crop season. | | | | |  | | | | |  | | | |  | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | |
| **4. RT4-Ma activity schedule** | | | | | | | | | | | | | | | | | | |
|  | | | | *2014* | | | | | | | *2015* | | | | *2016* | | | |
| *Activity* | | | | *Q1* | *Q2* | | *Q3* | *Q4* | | | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Study pasture biomass and map grazing routes | | | | X | X | | X | X | | | X | X | X | X | X |  |  |  |
| 2. Document and validate local conventions | | | | X | X | | X | X | | | X | X | X |  |  |  |  |  |
| 3. Study participatory conflict management | | | |  | X | | X | X | | | X | X | X | X | X |  |  |  |
| 4. Establish watershed for integrated research | | | |  | X | | X | X | | | X | X | X | X | X | X | X | X |
| 5. Model intensification/land use at village level | | | |  |  | |  |  | | | x | x |  | X | X | X | X | X |
| 6. Mapping landuse/land cover | | | |  |  | |  |  | | | x | x | x | x | x | x | x | x |

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| **5. Deliverables** | | **2014** | **2015** | **2016** |
| 1 | Interim and final reports on biomass quantity and quality | x | x |  |
| 2 | Map of grazing itineraries and pasture use intensity |  | x |  |
| 3 | Report on local conventions |  | x |  |
| 4 | Workshop report on conflict management | x |  |  |
| 5 | Journal article on local conventions |  | x |  |
| 6 | Maps of land use change of intervention communities |  | x |  |
| 7 | Report on transhumance practices and their effects on NRM |  | x |  |
| 8 | Report on the choice of technology parks and biophysical characteristics | x |  |  |
| 9 | Workshop reports on CBT for farmers in Bougouni and Koutiala |  | x |  |
| 10 | GIS maps and database on watershed |  | x |  |
| 11 | Journal article on watershed characterization |  | x |  |
| 12 | Report on CBT assessment and Model Development |  | x |  |
| 13 | Model development and exploration workshop reports |  | x | x |
| 14 | Working model code |  |  | x |
| 15 | LULC maps of the region @30m and 250m (1990, 2000, 2005, 2010, 2015) |  |  | x |
| 16 | LULC change maps and quantification tables |  |  | x |

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| --- | --- | --- | --- | --- |
| **6. Expected outcomes** | | **2014** | **2015** | **2016** |
| 1 | Farmers are adopting improved technologies to improve traditional farming | x | x | x |
| 2 | Communities are managing their natural resources without conflict |  | x | x |
| 3 | Scientists are validating and adapting the models developed |  | x | x |

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| **7. 2015 Budget (US$)** | |  |  |  |  |  |
| Theme/Activity | Budget line | ICRISAT | ILRI | AMEDD | MOBIOM | IER |
| RT3-Ma-1 | Personnel | 30000 |  | 2000 |  |  |
|  | Services | 15000 |  | 500 |  |  |
|  | Supplies | 15000 |  | 500 |  |  |
|  | Travel | 20000 |  | 1500 |  |  |
|  |  |  |  |  |  |  |
| RT3-Ma-2 | Personnel |  | 28318 |  |  |  |
|  | Services |  | 10782 |  |  |  |
|  | Supplies |  | 5750 |  |  |  |
|  | Travel |  | 5290 |  |  |  |
|  |  |  |  |  |  |  |
| RT3-Ma-3 | Personnel |  | 32758 |  |  |  |
|  | Services |  | 8482 |  |  |  |
|  | Supplies |  | 2875 |  |  |  |
|  | Travel |  | 5745 |  |  |  |
|  |  |  |  |  |  |  |
| RT3-Ma-4 | Personnel | 70000 |  | 2000 | 1500 | 10000 |
|  | Services | 12500 |  | 1000 | 500 | 7500 |
|  | Supplies | 17500 |  | 1000 | 500 | 7500 |
|  | Travel | 20000 |  | 1500 | 2000 | 5000 |
|  |  |  |  |  |  |  |
| RT3-Ma-5 | Personnel | 0 |  |  |  |  |
|  | Services | 2000 |  |  |  |  |
|  | Supplies | 5000 |  |  |  |  |
|  | Travel | 7000 |  |  |  |  |
|  |  |  |  |  |  |  |
| RT3-Ma-6 | Personnel | 20000 |  |  |  |  |
|  | Services | 10000 |  |  |  |  |
|  | Supplies | 5000 |  |  |  |  |
|  | Travel | 5000 |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Total** | **254000** | **100000** | **10000** | **4500** | **30000** |
|  | Grand total |  | 398500 |  |  |  |

**Theme 5: Nutrition, food storage, value addition and mycotoxin management (RT5-Ma)**

**1. Research team**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Name* | *Institution* | *Degree* | *Research interest* | *Role* |
| Caroline Makamto Sobgui | AVRDC | PhD | Public health nutrition | Theme leader |
| Eva Weltzien | ICRISAT | PhD | Sorghum breeding | Activity MT6-1 leader |
| Honafing Diarra | AVRDC | BSc | Nutrition | Training on nutrition |
| Pierre Coulibaly | AMEDD | BSc | Animal Nutrition | Field Extension |
| Fatimata Diallo Cissé, | IER |  |  |  |
| Salimata Sidibé | IER |  |  |  |

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| **2. Objectives** | |
| 1 | Improve women’s nutrition knowledge through nutrition field schools. |
| 2 | Evaluate options for improving the dietary diversity of households. |
| 3 | Evaluate post-harvest storage technologies. |

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| **3. Activities** | | |
| **Activity RT5-Ma-1** | Participatory evaluation of nutrition field school | |
| Lead Scientists(s) | Eva Weltzien | ICRISAT |
| Other scientist (s) | Caroline Makamto Sobgui, Fatimata Diallo Cissé, Pierre Coulibaly | |
| Location(s) | Koutiala (Mali | |
|  | | |
| Participatory approaches will be used to evaluate knowledge on nutrition, and on production of vegetables, legumes (and cereals). The following will be compared:   * Women knowledge on nutrition those who participated, and those who did not, possibly at different levels/intensities * Knowledge of production of vegetables, species and varieties among women who have access to gardens, and among those who produce in the rainy season * Knowledge of production of legumes by women: varieties, * Knowledge of production innovations for cereal production | | |
|  | | |
| Nutrition practices for children under 2 and pregnant and lactating women. This will involve the use of:   * Whole grain cereals for the family, for children. * Specific recipes, ingredients, cooking practices for children, and women. | | |
|  | | |
| Production practices in women’s fields, the family field, and possibly individual men’s individual fields   * Based on what women grow in their off-season gardens in Feb 2015 – evaluate changes in practices during the past 2-3 years * During September to October 2015 evaluate changes in production practices for rainy season crops in women’s fields, family fields and possibly men’s individual fields, focusing on families who participated in Nutrition Field Schools. (it could be compared with families who participated in field production activities, and those who did not in either). | | |

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| **Activity RT5-Ma-2** | Evaluate strategies for improving household nutritional diversity in Mali | |
| Lead Scientists(s) | Caroline Makamto Sobgui | AVRDC |
| Other Scientist (s) | Eva Weltzien, Diallo Fatimata Cissé, Pierre Coulibaly | |
| Location(s) | Koutiala | |
|  | | |
| 200 households with women and nursing mothers with children aged 6-24 months will be randomly selected from intervention communities. At least 100 households will be randomly assigned to one of the following treatments:  1. Behavior change communication training on nutrition and agriculture support in vegetables, legumes and cereals.  2. Agriculture support in vegetables, legumes and cereals.  The Behavior Change communication on improved nutrition practices and the agriculture support in vegetables, legumes (cereals) will be offered by extension workers. Extension workers will receive induction training prior to the beginning of the intervention, follow by an updating three months later. This will equip women, lactating mothers with children below aged 6-24 months and pregnant women, to adopt proper health care and nutritional practices.  A cluster non-randomized controlled trial will be used to collect quantitative and qualitative data on dietary diversity score, Knowledge, attitude and practices primary data from mother/child pairs. This means **a controlled** pre-test/post-test design involving two cross-sectional surveys at baseline and end point follow-up will be used to determine the outcome/impact of the program. **This will involve making** observations before and after the implementation of the intervention.  Comparison of selected indicators at baseline and at end of project will give an indication of changes that have taken place with time. Additionally, a comparison between intervention and control communities will show the changes which can be attributed to the program interventions. | | |

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| **Activity RT5-Ma-3** | Evaluate post-harvest technologies | |
| Lead Scientists(s) | Salimata Sidibé | Institute: IER |
| Other scientist (s) | Caroline Makamto Sobgui, Eva Weltzien | |
| Location(s) | Bamako | |
|  | | |
| This activity aims to develop post-harvest and conservation, and value Aadition techniques of locally available crops after harvest to reduce losses, enhance financial or nutritional crop-value, and assure food safety and security. This will be done by:   * Developing appropriate postharvest handling, storage and processing technologies that reduce losses, improve quality and food safety, and enhance smallholder farmers' food security and income. * Strengthening extension capacity to provide training in postharvest and preservation technologies and value-adding agro-processing technologies for resource-poor farmers, especially women. * Promoting use of improved postharvest processing and preservation technologies by resource-poor farmers, especially women. | | |

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| **4. RT5-Ma activity schedule** | | | | | | | | | | | | |
|  | *2014* | | | | *2015* | | | | *2016* | | | |
| *Activity* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* | *Q1* | *Q2* | *Q3* | *Q4* |
| 1. Evaluation of nutrition field school | x | x | x | x | x | x | x | x | x | x | x |  |
| 2. Improving household dietary diversity |  |  |  |  | x | x | x | x | x | x | x |  |
| 3. Adding value to crop products |  |  |  |  | x | x | x | x | x | x | x |  |

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| **5. Expected results/deliverables** | | **2014** | **2015** | **2016** |
| 1 | Report on nutrition field schools | x | x |  |
| 2 | Report on dietary diversity of households in the intervention areas |  | x | x |
| 3 | Report on improved post-harvest technologies |  | x | x |

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| **6. Expected outcomes** | | **2014** | **2015** | **2016** |
| 1 | Women are putting into practice knowledge from nutrition field schools | x | x | x |
| 2 | Households are adopting behaviours that improve their nutritional status |  | x | x |
| 3 | Households are adopting options to reduce post-harvest losses |  | x | x |

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| **7. 2014 Budget (US$)** | | | | |  |  |
| Theme/Activity | Budget Line | ICRISAT | AVRDC | AMEDD | IER | AMASSA |
| RT5-Ma-1 | Personnel | 16000 | 3000 | 3000 |  |  |
|  | Services | 16000 | 2000 | 1000 |  |  |
|  | Supplies | 1000 | 1000 | 1000 |  |  |
|  | Travel | 2700 | 2000 |  |  |  |
|  |  |  |  |  |  |  |
| RT5-Ma-2 | Personnel | 8000 | 22000 | 6000 | 2000 | 4000 |
|  | Services | 3000 | 8000 | 6000 | 1000 | 4000 |
|  | Supplies | 8000 | 12000 | 4000 | 1000 | 2000 |
|  | Travel | 6000 | 20000 | 4000 | 2000 | 2000 |
|  |  |  |  |  |  |  |
| RT5-Ma-3 | Personnel | 3000 | 3000 |  | 6000 |  |
|  | Services | 2000 | 2000 |  | 6000 |  |
|  | Supplies | 1000 | 1000 |  | 4000 |  |
|  | Travel | 2000 | 2000 |  | 2000 |  |
|  |  |  |  |  |  |  |
|  | Total | 68700 | 78000 | 25000 | 24000 | 12000 |
|  | Grand total |  | 207700 |  |  |  |

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|  | Theme |  |  |  |  |
| Partner | 1 | 2 | 4 | 5 | Total |
| ICRISAT | 60000 | 70000 | 254000 | 68700 | 452700 |
| AVRDC |  | 100000 |  | 78000 | 178000 |
| ICRAF | 54500 | 50000 |  |  | 104500 |
| ILRI |  |  | 100000 |  | 100000 |
| IER | 12,000 | 13300 | 30000 | 24000 | 79300 |
| MOBIOM | 3000 | 12500 | 4500 |  | 20000 |
| CAAD |  | 7000 |  |  | 7000 |
| GRADCOM |  | 7000 |  |  | 7000 |
| AMASSA |  |  |  | 12000 | 12000 |
| AMEDD | 4500 |  | 10000 | 25000 | 39500 |
| Total | 134000 | 259800 | 398500 | 207700 |  |
| Grand total |  |  | 1000000 |  |  |

1. The vegetable will be selected in consultation with farmers, IITA, AVRDC and NGO working in the area. [↑](#footnote-ref-1)